Worldwide Satellite Magazine February 2009

SatMagazine

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The Stateside View... *UPLINK*

From content delivery to crabbing to radomes, to an ASR solution to help with development and maintenance costs, transponder trends as well as a targeted mix of subject-matter expertise, this issue of ***SatMagazine*** focuses on the **U.S. satellite market**.

The breadth or product and range of company focus, as well as the products that comprise this world-leading market segment, could fill several books and magazines. Given our somewhat limited space, we hope we have focused in on material of interest to our readers and our "discussions" lead to the generation of ideas and appreciation for the creativity, performance, and economic sturdiness of the industries' craft.

Who Is On First...

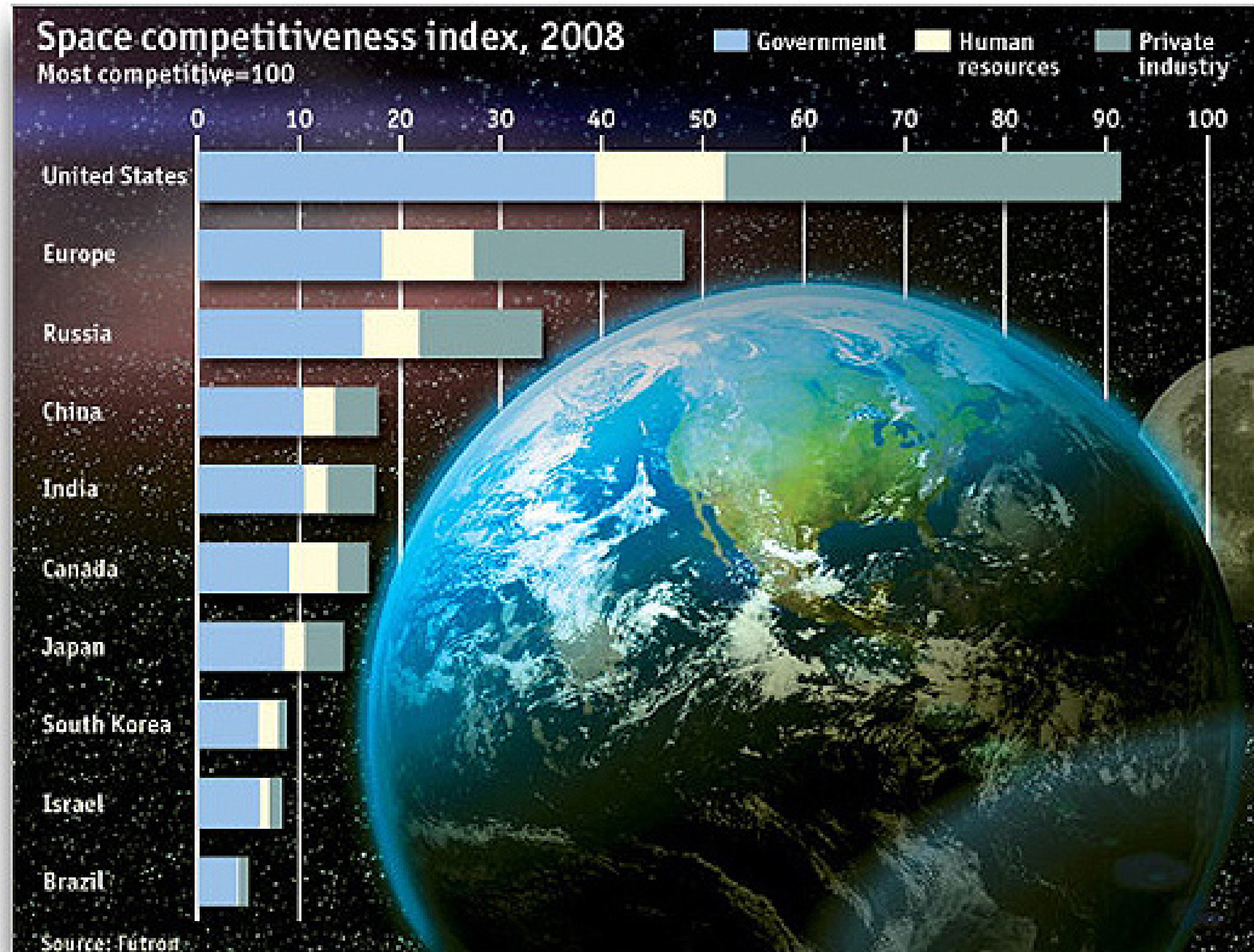
According to **Futron**'s ***2008 Space Competitive Index***, which examines the underlying economic determinants of space competitiveness across 40 individual metrics, the U.S. is the current leader in space competitiveness, as well as the significant leader in each of the major categories, which include government, human capital, and industry.

One should note that many forecasts find double digit growth in FSS in world markets *other* than the U.S. — for example, **Euroconsult's** ***World Satellite Communications & Broadcasting Markets Survey, Market Forecasts to 2017*** report from September of last year finds fixed satellite sector growth in transponder demand (+8 percent) and overall revenues (+9.5 percent) — with double digit growth rates during 2007 in Russia & Central Asia (+20 percent), South Asia (+20 percent), Central Europe (+20 percent) and Sub Saharan Africa (+19 percent). The U.S. didn't make the double digit growth cut! Increased global competition is going to cause U.S.-based firms to take a significant look at the way they manage their business, not only to gain significant growth, but also to remain as viable options for satellite systems and services.

In another Euroconsult report, ***Government Space Markets, World Prospects to 2017***, planned satellite launches by world governments should see a 38 percent increase in launches over the next 10 years. During 2008, world government space program expenditures reached historical highs of more than $62 billion dollars. This was further analyzed by Euroconsult as follows:

- Earth observation is the number one satellite-based application worldwide, with government spending $6.7 billion in 2008, i.e. 20 percent of government non-classified investment in space. Lower cost satellites and ability to address local issues has made EO the top priority application for a number of countries, particularly emerging space programs. Strong growth is expected to continue in civil programs, while expenditures for defense and security programs are likely to stabilize at current budget levels.

- Investments in satellite communications (Satcom) programs have been growing steadily reaching $6.6 billion spent in 2008 for both non-classified defense and civil programs. Overall, 128 satellites are planned for launch in the next decade driven by the defense sector as well as projects in developing countries.



Space Competitive Index Chart, 2008, courtesy of Futron

- Satellite navigation (satnav), $2.6 billion in 2008, has been the fastest growing application in terms of public-sector investment (+21 percent per year over the past five years). In addition to GPS next-generation satellites developed in the United States, Europe, Russia, India, Japan, and China are investing in a new satellite navigation system that should boost the expenditures to $3 billion in 2010. 144 satellites should be launched for navigation applications between 2008 and 2017, i.e., over double that of the past decade.

As ***Steve Bochinger***, Director, Institutional Affairs at Euroconsult, said, "Government space programs are driven by long-term strategic national objectives which are typically less influenced by short-term economic downturns. On the other hand, the economic slowdown may induce governments to increase their investments on infrastructure-related programs to support their economies."

What is clearly interesting is that 95 percent of civil space programs funding, which accounted for nearly $33 billion spent by 40 countires according to Euroconsult, is concentrated in the United States. Expect additional spending to make its way into satellite industry coffers as the government maintains curernt programs and examines new satellite channels.

Satellite-related applications are clearly driving growth in government programs worldwide, with a large number of countries committing to developing or acquiring satellite systems for their own use in specific programs. The question is, with new companies and products entering the market in the U.S., and overseas, and with acquisitions once again in vogue, will such offset budget decreases planned by major players? The answer won't be known for several months.

Hartley Lesser, Editorial Director

Transponder Trends In North America

by Patrick M. French, NSR

In many ways, the mother of true commercial satellite transponder leasing services is the North American C-band video services segment. Commercial satellite C-band payloads in the North American "cable arc" are used to bring all kinds of television programs to literally tens of millions of households. This television content is not only delivered via cable MSOs, but nearly every television affiliate station in the U.S. and Canada receives at least some (if not all) of its daily television programming via C-band satellite capacity. Further, substantial programming contribution and even some SNG services are still C-band based in North America. Even the IPTV segment in the region is largely a C-band phenomenon for the moment. All of these markets constitute what NSR labels as C-band video services and accounted for an estimated 87 percent of all commercial C-band transponder leasing in North America for the end of 2008.

It is true that over the last two decades, Ku-band capacity has come to play a somewhat larger role in the North America market (55 percent Ku-band to 45 percent C-band), notably due to DTH and various consumer and enterprise broadband services. One must never forget it was C-band that started it all in the 1970s and, because of this heritage position, still largely dictates how television gets to the majority of North American households. Understanding the current trends for C-band video services today requires looking at the market from a number of different angles.

Sorting out conflicting channel trends in C-band video distribution services

In sorting out C-band demand trends, various subsegments must be individually separated for analysis. **NSR** first divides the C-band video distribution market into the cable headend and general network (*i.e.,* **ABC**, **CBS**, **NBC**, **FOX** and **CBC**) channel distribution services from the C-band IPTV market. Next, NSR separately assesses analog, SD, and HD channel trends in each of these segments. First looking to the cable headend and network distribution sector, this is actually the traditional core of the market and counts for, by far, the most channels and leased capacity.

AMC-18 satellite

Galaxy-13 satellite

There are still a substantial number of C-band analog channels remaining in the North American market, but these have been on the decline for years now. For broadcasters, the end of analog broadcasting is not only a major revenue saver (given that it still typically takes a full transponder to carry a single analog channel), but it also frees up the capacity for the all important growth in HD and SD channels. Between 2003 and 2007, nearly 80 percent of the C-band analog channels carried for the North American market had already been converted to digital. NSR expects the trend to continue until all analog channels are assumed to finally disappear around 2014.

In 2008, the majority of the C-band SD channels for the North American market were for cable headends and network channel distribution as part of the overall video distribution market. SD channels continue to see steady growth, with occasional years experiencing major gains such as in 2008 due to the launch of **Comcast Media Center**'s new ***HITS Quantum*** bouquet on ***AMC-18***. A small sampling of other new channels launched over the last 18 months in the North American market include **Spanish Broadcasting System**'s ***Mega TV*** channel carried by **Intelsat** on ***Galaxy-13***, **OlympuSAT**'s renewal and expansion of capacity on Intelsat's ***Galaxy-23***, and ***WealthTV*** from **Herring Broadcasting, Inc.,** also being carried Intelsat's ***Galaxy-13*** satellite.

NSR, nonetheless, expects slower SD channel increases through 2009 with the poor economic conditions being the culprit. However, an eventual economic recovery will no doubt lead to a spike in channel additions in the 2010 and 2011 period.

The most important trend in the C-band cable head-end and network distribution market in North America is the rapid increase in **C-band HD channels**. NSR's research shows that HD channels in 2007 increased by 78 percent over 2006. In 2008, it appears that there will be a doubling of HD channels launched for cable headends and network distribution services with the HITS Quantum bouquet playing a large role in the 2008 gain.

Other recent contracts for HD channel launched include **Crawford Satellite Services** launching ***MavTV*** and ***World Fishing Network*** (**WFN**) on ***AMC-10***, **Intelsat** carrying a new HD channel for the **National Hockey League Network** on ***Galaxy-15***, **QVCHD** going up on **SES Americom**'s ***AMC-11***, and **Rainbow Network Communications** signing a multi-year capacity contract on ***Galaxy-14,*** with Intelsat to deliver HD programming into the North American cable market. NSR anticipates that HD channel launches will continue strong through 2009 and 2010 despite difficult economic conditions because HD has become such a key differentiator and revenue driver for cable operators that they will need the HD content in order to keep competitive, especially in their ongoing battle with DTH services.

IPTV Market Gaining Traction … Or Is It?

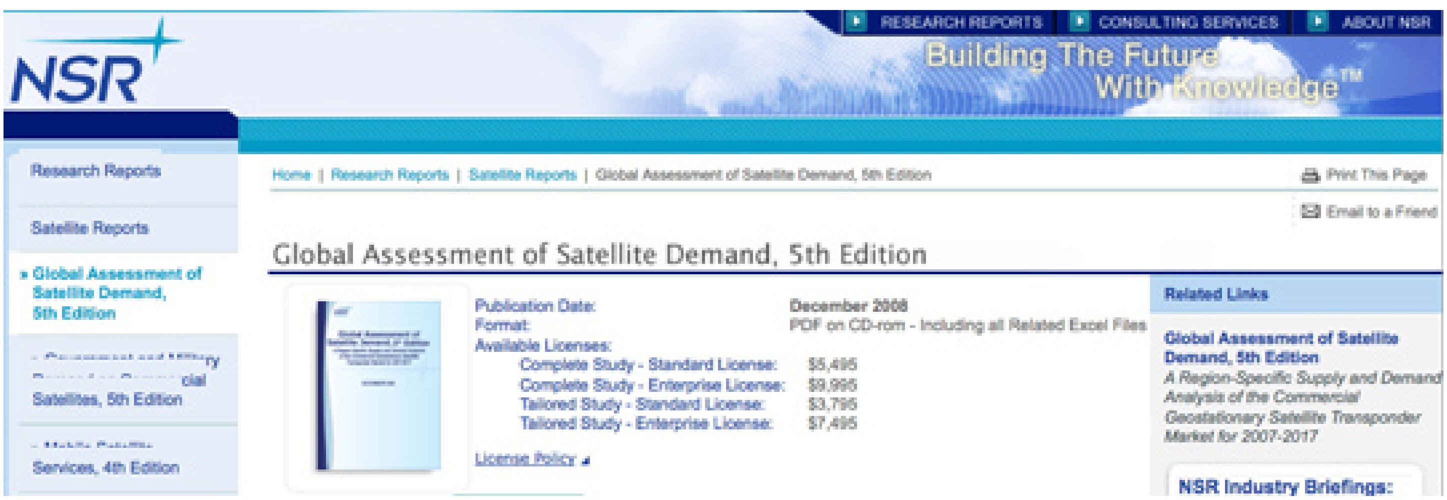
The IPTV market in North America appeared to be picking up steam over the course of 2008 as a number of competitors begin to nail down a substantial number of contracts. **SES Americom** announced in November 2008 that more than 65 telcos in 31 states had signed up for ***IP Prime,*** with two dozen of these already commercially delivering the IP Prime service to subscribers and another dozen expected to "turn on" by the end of 2008. ***Avail Media*** had also grown its customer base with its linear IPTV service having 20 customers in 14 states in the U.S. as of the close of August 2008. Further, the company launched its HD channel service in June 2008 and should offer over 50 HD channels as of the start of 2009. Intelsat continues to market its Intelsat IPTV service as well, and the Intelsat IPTV platform is used for the SD channel content for the **Avail Media** IPTV service.

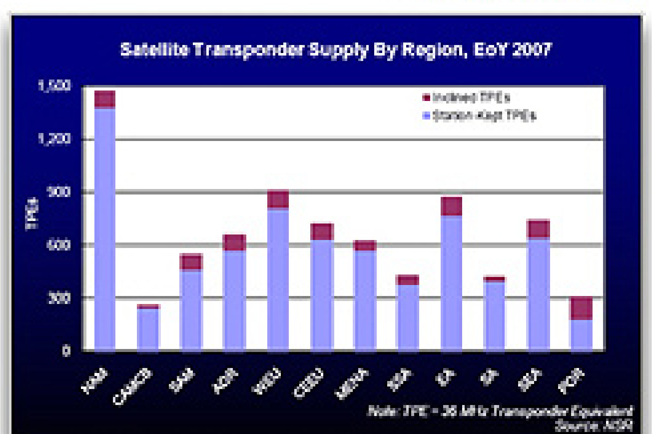
From the capacity leasing point of view, NSR only considers those IPTV service providers that actually lease capacity from a satellite operator or use a dedicated portion of a satellite payload for an IPTV service. Beyond those companies cited above, there are many additional content rights aggregators and system integrators that play in the IPTV market, but who do not directly account for leased satellite capacity. NSR's methodology includes IP Prime and Intelsat IPTV as part of the C-band IPTV market, and Avail Media also has a long standing contract with **Telesat** for C-band satellite capacity.

NSR's only long term concern expressed in its ***Global Assessment of Satellite Demand, 5th Edition*** (**GASD5**) study for the IPTV market was if one of these services were eventually to fold. This concern became reality several weeks after releasing the GASD5 study, as SES announced that it would shut down its IP Prime service by mid-2009 due to slow subscriber uptake and the failure of the service to meet internal rate of return goals. Hopefully companies see IPTV as central to their businesses, not a sideline, and will continue to have the wherewithal to develop IPTV services in North America over the longer-term.

The Market Is In Contraction

As noted above, a considerable amount of North American C-band transponder capacity continues to be used for classic contribution and *occasional use television* (**OUTV**) services, including some for SNG services. Roughly two-thirds of the leased C-band capacity attributed to the North American video contribution and OUTV market is used to provision analog feeds for the region. Since 2003, the number of analog C-band





feeds attributed to market has dropped by a third, and NSR has every reason to expect a continued slow, gradual decline in the use of analog feeds for full-time video contribution services.

The good news is that C-band analog feeds are converting to digital at a less rapid pace than C-band analog channels. NSR expects some C-band analog feeds will continue to be used through 2017. The bad news is conversion of analog feeds to digital does not create enough new digital C-band feeds to absorb the freed up capacity. The net result is declining C-band transponder demand for video contribution & OUTV. While C-band has a heritage in the North American market for video contribution & OUTV services, there is a clear migration of this market to Ku-band in order to support lower cost equipment, most especially for the various occasional use and SNG markets.

Wrapping Up Services + Supply

With the demand trends for the various video services markets shown above, NSR estimated in the GASD 5th Edition study video services generated about 350 C-band TPEs (36 MHz transponder equivalents) of commercial capacity demand in 2007. This is expected to rise to about 425 C-band TPEs in 2012, driven mainly on the strength of SD and HD channel growth, though exclusion of the SES IP Prime service from 2009 onward reduces this amount by about 20 C-band TPEs.

From 2013 through to the end of the forecast period in 2017, NSR predicts relatively flat C-band capacity demand for video services mainly because the rate of growth in HD channels will likely slow and continued analog to digital channel conversion plus declining contribution & OUTV market offsets much of the gains coming from SD and HD channel gains. Additionally, movement to MPEG-4 compression also leads to flattening capacity demand.

How does this contrast against C-band transponder supply for the region? NSR has adjusted its North American C-band supply estimates from its GASD 5th Edition study to only reflect satellites traditionally thought of as part of the North American cable arc and also removed satellites designated as dedicated in-orbit backup capacity. This places North American C-band cable arc station-kept supply at over 550 TPEs in 2007, and this is projected to climb to in excess of 625 TPEs by 2010.

Reasons for the supply growth are varied, yet mainly center on fleet upgrades that are replenishing capacity that is not available due to satellite anomalies, replacing capacity that is currently in inclined orbit with station-kept capacity, or replacing capacity that was for North America but has recently been reallocated to other markets like South America.

After 2010, NSR expects C-band supply to drop again as the current replacement cycle slows and also in response to satellite operators trying to better tailor their in orbit C-band supply for North America to actual demand levels.

C-band video services transponder demand is a substantial and growing user of commercial C-band cable arc transponder supply. Accounting for about two-thirds of C-band cable arc supply in 2007, C-band video services will make use of approximately three-quarters of the C-band cable arc supply by the end of the forecast period. It is noted that this is not a fill rate as there are other C-band markets that make use of the commercially available supply, but video services certainly account for the large majority of overall C-band demand in North America.

Overall, the satellite industry and satellite operators tend to make a big fuss over growth in HD and (until recently) the prospects for IPTV services. These are no doubt important markets as they are certainly driving new C-band demand in the North America market. Just as importantly, and too often overlooked or ignored, is the fact that HD channel growth and IPTV, as well as regular old gains in carriage of SD channels, goes to fill big holes created by the conversion of analog channels and feeds to digital, as well as using up capacity that has been freed up by migration to more efficient broadcasting technologies like MPEG-4.

From NSR's point of view it appears that once the period of rapid growth in HD content carried on C-band capacity and emergence (and hopefully survival) of IPTV is past, the North American C-band market will likely enter into a period of slow growth. This is, of course, unless some new video application is found to help fill up the C-band cable arc satellites. This will be a major preoccupation for North American satellite operators in the coming years as they experiment with new uses for the mother of commercial satellite services ... C-band.

About the author

Mr. French joined Northern Sky Research in September 2003 and has since authored numerous studies, the most recent being the Global Assessment of Satellite Demand, 2nd. Edition and Broadband Satellite Markets 5th. Edition. He has sought to expand NSR's coverage of the satellite industry into areas such commercial satellite supply and demand modeling, video distribution and contribution, DTH, telephony and narrowband VSAT networks. In addition, he has undertaken client specific projects in diverse satellite applications and intends to broaden NSR coverage of the European satellite industry.

From 1990 to 1999, Mr. French was a staff member of the International Space University (ISU), first in Cambridge, Massachusetts and then 6 ½ years at ISU's Central Campus located in Strasbourg, France. Mr. French held numerous positions within ISU organizing conferences, short courses, and workshops. In parallel, he was responsible for managing the development of the new ISU Central Campus facilities that were completed in mid-2003.

Following his work at ISU, Mr. French joined Frost & Sullivan where he rapidly advanced to the position of Strategic Analyst for the Satellite Communications group. While at Frost & Sullivan, Mr. French authored eight studies, led numerous consulting projects, and tracked other diverse markets such as satellite television, launch services, emerging satellite applications and content delivery networks.

by Carlton van Putten, Blue Sky Network

The Past, The Present, and The Future

Low Earth Orbiting (**LEO**) satellite systems provide various satellite communications systems and handheld satellite services in North America. Ten years ago, mobile satellite services (**MSS**) took communications to a new level in making handheld satellite services portable for the first time.

Today, four MSS operators offer voice and data services to North America. Depicted below are the basic services offered and available from each provider.

	Handheld Service - Highly Portable/Low Cost	Voice Service	Data Service	Nearterm System Continuity	Independence from Terrestrial	Interoperability	Global Coverage	Nearterm System Funding	Next Generation System Definition	Established Distribution & Support System	Asset Tracking Optimized
Globalstar	●	O	●	O	O	○	O	O	●	●	●
Iridium	●	●	●	●	●	●	●	●	O	●	●
MSV	O	O	●	O	O	●	○	O	●	O	O
Inmarsat	○	●	●	●	O	●	O	●	●	●	O

Key: ● = optimal; O = partial; ○ = limited or not available

System	Service Types	Services Currently Available in North America	Terminal Types in North America	Next Generation Services Planned
Globalstar	Voice, Data	Voice service limited due to satellite anomalies; sporadic although predictable outages Data services fully available	Handheld	Up to 256 kbps from the handset; up to 1 Mbps downlink to users
Iridium	Voice, Data	Voice and data services fully available	Handheld	Up to 64 kbps for handheld; up to 128 kbps for mobile broadband; up to 1 Mbps for mobile high speed service
MSV	Voice, Data	Voice and data service fully available	Mobile, hand-portable	Voice, data, multimedia integrated with terrestrial via ATC
Inmarsat	Voice, high-speed data	Voice and data services fully available	Mobile, portable	Circuit-switched up to 64kbps ISDN; packet-switched up to 492 kbps

Mobile Satellite Services: Status Check for First Responders, June 2009
Source: FUTRON

When considering the tables on the previous page, it is important to know specifically what it is you are looking for or hope to accomplish with your satellite coverage. If a company's primary concern is data services, then any provider will deliver optimal coverage.

However, if a primary concern is global coverage, there is only one service of choice that offers optimal coverage while another provider does not have any degree of coverage available. Let's say for example that voice and mobile data services are options you would like to have available, but you do not require optimal coverage of these features. In this instance, a company can settle for partial coverage from a company such as **SkyTerra** (*formerly Mobile Satellite Ventures — MSV*) as opposed to necessitating optimal coverage from a provider like **Iridium**.

The satellite provider of choice for any company depends upon the services they require. The graph on the previous page does show that services vary, but to get the best overall service, the choice is clear. Something also important to consider when reviewing current services is to ask what services will made available in the near future? The first table on the previous page offers a glimpse into what nexgen services are planned to be made available to customers.

in addition to the four satellite providers outlined in the tables, there is one new anticipated player — **TerreStar** — which has two satellites under construction and is planning their first launch in either this year or next (originally scheduled for 2007/8).

TerreStar's ***TerreStar-I*** will be the world's largest and most powerful commercial satellite and is expected to better existing satellites' signal sensitivity and number of spot beams generated. Such a system would cause quite a change for MSS in the U.S., but there are currently major uncertainties and risks associated with the system. These "challenges" include prolonged financing and the actual building and launching of satellites.

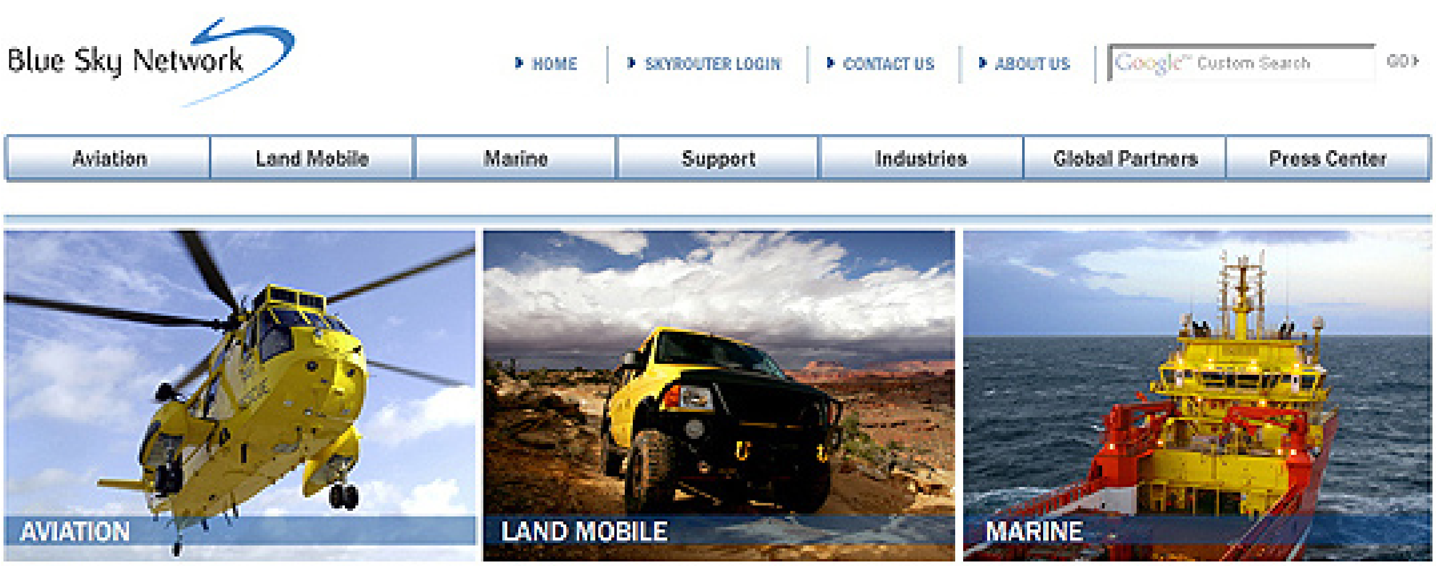
Assuming these concerns do not become a problem, TerreStar's planned all-IP next generation mobile communications network over an integrated satellite-terrestrial system still depends on successfully deploying satellites and implementing an ATC network in order to leverage FCC licenses.

Major Decisions

The major contenders in the U.S. satellite market: **Globalstar**, **Inmarsat**, **Iridium**, and **SkyTerra** are each able to offer different services, strengths, and weaknesses. The key to provider selection is in knowing which services, and the quality of those services, willl be available today and in the future.

About the author

As Senior Vice President of Sales and Marketing, Carlton van Putten is responsible for worldwide sales and marketing for Blue Sky Network. His responsibilities encompass sales and channel management, corporate communications, and product marketing activities In more than a decade of senior management experience, Carlton has filled several senior management positions at both start-ups and multinational corporations including COO of Maredy Corporation, President of Rivus Internet Group, and as Vice President of Marketing at Stream International and Focus Enhancements. Earlier in his career, he held several marketing and sales positions at "A-list" companies like Apple Computer, and has worked to help them develop and execute business strategies that refine their focus and capitalize on emerging market trends. van Putten holds a Bachelor's degree in Psychology and Business Administration from the University of California, Los Angeles.



The U.S. Market Drives Satellite Technology & Applications

by Rachel Villain, Director, Space & Communications, Euroconsult, Paris

The United States and Canada have pioneered satellite communications services and today the U.S. is the world's largest market for satellite-based services, all applications combined (SATCOM, SATNAV, and Earth observation).

This statement is consistent with two facts...

- the U.S. government is the world's lar est satellite operator
- commercial satellite applications emerge earlier in the U.S. than in the rest of the world as a result of early deregulation of satellite service provision and easier access to capital financing

A Large Industry With A Large Customer Base

The U.S. space satellite manufacturing and launch industry had record sales of almost **$40 billion in 2008**, thanks to its access to the world's largest government market including the **DoD**, **NASA**, and the **DoC**. In addition to the captive U.S. government market, U.S. satellite and launch vehicle manufacturers also serve a large domestic commercial market (communications and Earth observation satellite operators). In that market, US manufacturers enjoy high market share — of the 20 geostationary comsats launched for U.S. commercial companies over the past three years, 17 were manufactured in the U.S.

The U.S. satellite service industry (which markets satellite capabilities) had roughly the same sales volume as the upstream space industry in 2008, primarily from six businesses:

- *Fixed Satellite Services (FSS) with three companies (SES Americom, Intelsat and Telesat) serving U.S. and foreign telcos, ISPs, celcos and broadcasters in the U.S.*
- *Mobile Satellite Services (MSS) with five companies providing enterprises and government agencies in the U.S. with mobile voice and/or data services:* ***Inmarsat****,* ***Iridium****,* ***Globalstar****,* **Orbcomm***, and* ***SkyTerra*** *(formerly MSV).*
- *Direct-to-home digital TV Broadcasting Services (DBS) with two vertically integrated satellite broadcasters (****DirecTV*** *and* ***Dish Network****), together serving about 33 million U.S. subscribers*
- *Digital Audio Radio Services (DARS) with one vertically integrated satellite broadcaster (****Sirius XM Radio****) serving about 20 million U.S. subscribers*
- *Consumer two-way broadband satellite services with two vertically integrated satellite service providers (****WildBlue*** *and* ***HughesNet****), together serving almost one million U.S. subscribers*
- *Earth observation data sales with two vertically integrated satellite companies (****GeoEye*** *and* ***Digital Globe****) primarily serving the NGIA and other government agencies, as well as virtual globes and geospatial companies.*

These 15 companies feed an ecosystem of terminal manufacturers, resellers and application developers that is unequalled elsewhere in the world. They demand a lot from satellite technology providers so as to introduce innovative services to their own customers — whether consumers, businesses, or government agencies.

In addition to satcom and Earth observation, satellite navigation is the third area where commercial services have developed thanks to the availability of satellite infrastructure (GPS) financed by the DoD. Today, **Magellan**, **Navteq**, **Trimble**, and **Raytheon** serve their domestic market and compete internationally on a growing market of GPS-enabled terminals.

Using launch mass of geostationary satellites as a metrics for satellite capabilities — reasoning that more power, more bandwidth, more lifetime result in bigger satellites — U.S. satellite operators and manufacturers have always been at the cutting edge of performance of the industry.

Satellite Communications & Broadcasting Market Survey: World Prospects to 2017

In 2008, **ICO** launched its first geostationary satellite, the world's largest to date at 6,600 kg, and **ViaSat** ordered a multispot beam band Ka-band satellite capable of 100 Gbps. In the area of Earth observation, GeoEye anticipates launching ***GeoEye-2*** with 0.25-m ground resolution. ***GPS-3***, now in development, will feature a cross-linked command and control architecture and a new spot beam capability for enhanced military (M-Code) coverage and increased resistance to hostile jamming.

Adapt To Changing Market Environs

Innovation in the U.S. satellite industry is not just about technology — as the various business models tested over the past few decades illustrate.

The first experiment in public-private partnerships in space occurred in the U.S. for the ***TDRSS*** and ***Leasat*** satellite systems for NASA and the DoD, but U.S. government

Government Space Markets: World Prospects to 2017

procurement schemes for space systems have since returned to cost-plus contracting.

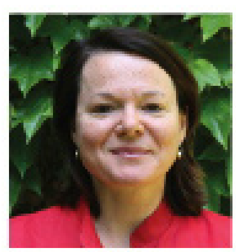
Vertical integration produced mixed results for **OSC** and **Loral Space & Communications**, which both divested entirely or partly from the service business to concentrate on the space system business. For satellite operators, the acquisition of service companies downstream seems to have been more beneficial. Examples include **Intelsat** (which acquired **Comsat General)**, **SES Americom** (which acquired **Verestar)**, and **Telesat** (which acquired **Spaceconnection)**. U.S. commercial satellite operators have also introduced the cost-effective and rapidly deployed solution of hosted payloads where government dedicated payloads are piggybacked on commercial satellites.

Consolidation is now the rule at every level of the value chain in the U.S., as the space market matures and competitors seek improved profitability, and shareholders look to maximize their returns on investment. At the manufacturing level, the two largest events were **Boeing**'s acquisition of **Hughes Space & Communications** in 2000 and **Northrop Grumman**'s acquisition of **TRW** in 2002. Since then, consolidation has reached smaller companies manufacturing small satellites for low Earth orbit, with **ComTech Aero**, **Sierra Nevada**, and **ATK** emerging as new players.

Lower in the value chain, consolidation among satellite operators started in the late 1990s with the acquisition of **HCI** by **PanAmSat** and culminating with **Intelsat** acquiring PanAmaSat in 2005. In the satellite service business, companies have changed shareholders (if not name) through merger and acquisition (*e.g.* **Arrowhead**, **Spacelink**) in the aftermath of the telecom crisis of the early 2000s

But technological superiority comes at a price. Financing for advanced developments for future government and commercial satellites in the U.S. is now uncertain, with a new Administration and the collapse of the financial markets. This is why U.S. companies will continue to restructure and consolidate all along the satellite services value chain, resulting in more opportunities for partnerships and acquisitions by foreign companies.

About the author



Rachel Villain, Director Space & Communications at Euroconsult, Paris, with inputs from Euroconsult's ***Satellite Communications & Broadcasting Market Survey: World Prospects to 2017*** *and* ***Government Space Markets: World Prospects to 2017****.*

State of the SATCOM World

by Tim O'Neill, Consultant

Today there appears to be disconcerting news everywhere for most business sectors. However, what I personally see and hear is that this shaky time seems to have little or no real effect on the SATCOM arena. You may arrive at a different opinion, but there seems to be a lot of "light" ahead for our industry over the coming years, for the following reasons...

First — The global appetite for video, voice, and data access (Internet as well as private) is not slowing! Many nations are demanding access to communications networks and extraterrestrial access — satellites are the best solution for their needs.

Second – Today's applications (voice, video and data (Broadband) plus SatTV are extremely bandwidth hungry! The technical requirements continue to grow. Therefore, so will the new technologies coming online to replace older stations and access.

Third – The technology for using satellite based access is more powerful, versatile, and lower priced than ever before in SATCOM history! This includes off-shore platforms and service vessel accessibility. The control and live access needs of Industrial Ethernet are driving more connectivity. As a result, SATCOM demand will find the Industrial Ethernet market is expected to grow at 21.7 percent CAGR over the next 5 years (**IMS Research**).

Fourth – Defense needs are still increasing for a majority of nations!

The **International Space Business Council** suggests that the Private and Government sales will reach to US$158 billion by 2010.

U.S.-based satellite data communications company **Orbcomm** received regulatory approval and authorization to provide its two-way satellite data communications services in Nigeria, Singapore, Republic of Cyprus, and Mongolia.

World government space program expenditures reached a historic high value of more than US$62 billion in 2008. Planned satellite launches in the next ten years are expected to increase 38 percent over the previous decade, according to a report released last December by **Euroconsult.**

A number of new universal access programs have come to light since NSR's well-planned ***Broadband Satellite Markets 7th Edition*** study was released in June 2008:

The **France Numérique 2012** plan has entered the competitive phase with several potential service providers, including **SES Astra** and **Eutelsat** as well as **Orange**, all seeking to furnish broadband services to the estimated 1.7 percent of the population that fall into aDSL "white spaces". The goal is to offer broadband services at a speed in excess of 512 Kbps and a price (including the equipment) of less than 35 euros per month by the end of 2010.

The **Irish Ministry of Communications, Energy and Natural Resource** launched a 10-point plan in July 2008 that included the delivery of universal broadband access to the estimated 10 percent of households not served in Ireland between late 2009 and early 2010. A competition was launched, and a winner was recently announced, that being "**3**", a **Hutchinson Whampoa Company.**

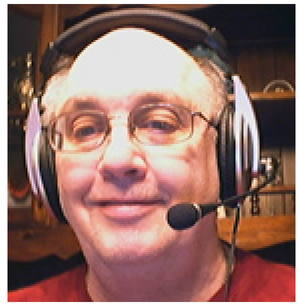
In October 2008, the **European Union** issued a report mandating universal broadband access for all EU countries. The current goal is to start the consultation and discussion process to introduce this legislation by 2010. Many issues need to be addressed including defining minimum acceptable broadband speeds and what, if any, EU funding will be used to aid counties in meeting the universal access mandate.

The above are just a number of the more recent universal broadband access programs and do not include earlier programs such as in Switzerland, which was won by **Swisscom**, and numerous smaller, regional programs in parts of the U.K. and other nations in the EU. **NSR** is seeing real momentum being attained in these universal access programs and fully expects that many other countries in the EU will announce additional projects in the coming years.

Most of this information was contained within the **NSR** (Northern Sky Research) report entitled: ***Broadband Satellite Markets: 7th Edition***.

In light of such developments and the continuing positive news for the SATCOM markets, any state of panic should be forestalled as there are good years ahead. If you have doubts with this statement, simply read the daily news at ***SatNews*** to become a believer!

About the author



Tim O'Neill "Oldcommguy®" is an independent technology consultant currently working with YR20. He has more than 35 years experience working in the WAN, Analog, ISDN, ATM and LAN markets. Tim also has several years experience in the oil, gas and petrochemical instrumentation arena. Tim has been responsible for technology and designed many products for companies such as GeoSource, Navtel, Network General, Ganymede and ClearSight Networks and is now helping companies get lab and market recognition with technology verification. Tim is also the Chief Contributing Editor for LoveMyTool.com, a website designed to help network managers gain access to valuable information and real solution stories from other customers. Tim is a patent holding, published and degreed engineer, who has seen this technology grow from Teletype (current loop) data analysis to today's 10 Gigabit LAN's focused on business applications with heavy compliance demands. Tim has been a consultant on several movies and has been involved with law enforcement and industry at all levels from engineer to senior executive. He helped design and bring to market the first WAN DataScope in 1976. Contact Tim at ***tim@oldcommguy.com*** *by Rod Tiede, President + CEO, Broadcast Int'l*

The ability to reduce video bandwidth needs has become critical as the demand for video skyrockets among consumers and businesses alike. A new study from TNS and the Conference Board shows that, since 2006, the number of U.S. households watching TV programming online has nearly doubled.

A front page ***New York Times*** story warns of the threat posed by "video road hogs" which are jamming up the Internet by users uploading and downloading videos. At the same time, traditional TV viewing has not decreased; rather, users are demanding more and higher-quality content. In 2007, *Stan Schatt* of **ABI Research**, a leading broadcast industry research firm, warned, "Cable providers are going to get killed on bandwidth as HD programming becomes more commonplace." All media delivery platforms, whether satellite, broadcast TV, IPTV, Internet video, and wireless all face the same challenge: lack of video bandwidth.

Broadcast International has developed ***CodecSys*** video compression technology to break the video bandwidth barrier. CodecSys is a family of ultra-high performance, video compression solutions, built on the industry's first "future-proof" open software architecture. The CodecSys software suite ranges from market-specific solutions, such as **H.264** encoding for the IPTV and Internet video markets, to the industry's first *Video Operating System* (**VOS**), supporting multiple codecs and providing advanced transcoding capabilities for video re-purposing and media management.

"These solutions are designed from the ground up to evolve and change with the video delivery infrastructure, while providing the highest quality video at the lowest possible bandwidth," said *Rod Tiede*, Broadcast International president and CEO. "The key advantage of the CodecSys software in the rapidly changing world of video delivery is its completely open architecture, enabling it to readily accommodate new codecs and standards as they come on the market."

This concept is in sharp contrast to other competitive solutions, which rely on single codecs and embedded hardware/software architectures that are rendered obsolete as soon as a new codec or standard emerges. For example, there are literally billions of dollars in video compression infrastructure on the market that will become useless when the new generation of H.264 standard codecs are widely adopted. Following closely on the heels of that standard is ***JPEG 2000.*** With CodecSys, upgrading to a new codec standard is as simple as downloading a new software upgrade. Only the patented open architecture of CodecSys can readily incorporate new standards and technologies, providing an "ever-green," future-proof solution to customers.

CodecSys Patented Multi-Codec Support

CodecSys multi-codec software is patented video compression technology that reduces bandwidth needs by more than 80 percent for HD-quality video over satellite, cable, IP and wireless networks. By dramatically reducing video bandwidth requirements, CodecSys's multi-codec software will enable a new generation of video applications — live streaming video over the Internet and via mobile devices. For existing applications such as HDTV over satellite or cable, CodecSys currently provides unprecedented price/performance benefits enabling multiple HDTV channels to be broadcast over the same media that currently support only single channels.

CodecSys achieves its breakthrough performance through a patented architecture that uses artificial intelligence to analyze a video stream and then select the codec best-suited to a particular video frame sequence from an entire library of specialist codecs. These specialist codecs are designed to handle particular types of high-bandwidth video frames or streams, such as fast-motion sequences in a basketball game or explosions in an action movie. These video streams are extremely bandwidth-intensive and pose chokepoints to generalist codecs. By selecting the best expert codec for the job, CodecSys is able to eliminate these chokepoints and offer performance several times higher than competitive products based on single, general-purpose codecs for every type of video stream. The graphic below depicts the benefits of switching between multiple codecs.

CodecSys: How it Works

CodecSys is suited to solving the problems posed by video delivery over any platform, whether IPTV, cable, wireless or Internet. A key feature of the system is its use of a library of video and audio compression codecs in a "just-in-time" fashion in order to dynamically leverage the strength of each codec rather than trying to use a "one-size-fits-all" approach. This produces a multi-codec video stream that exhibits superior compression, quality, security, and adaptability over the traditional uni-codec encoded multimedia stream.

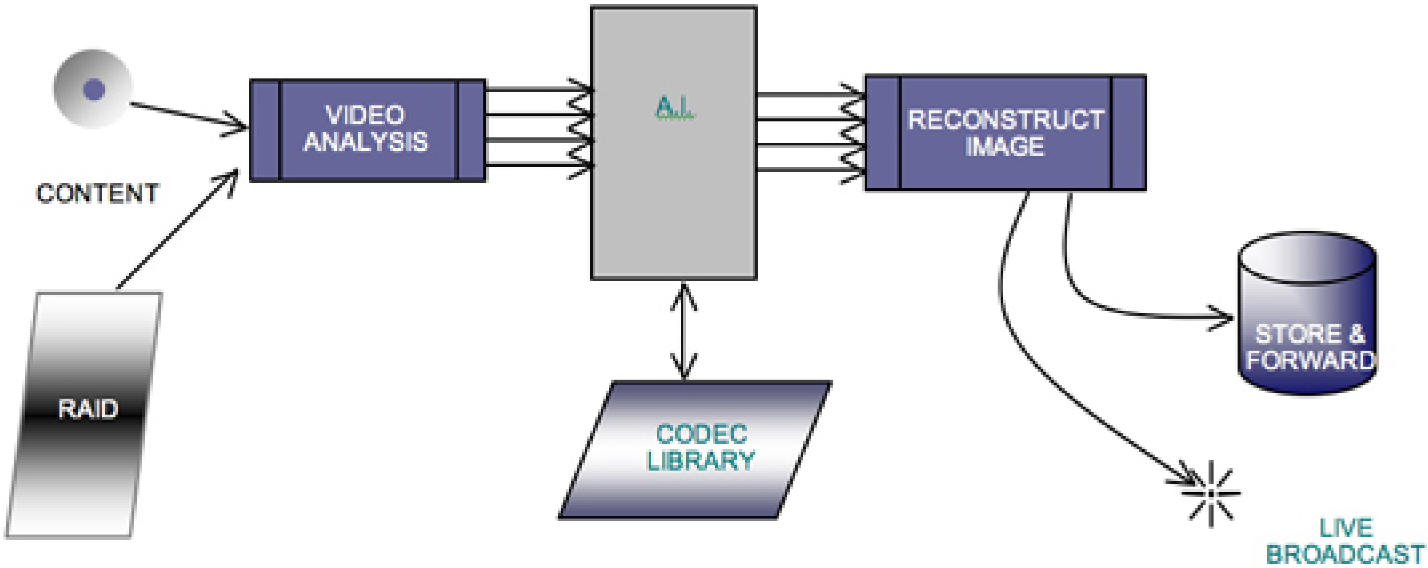
"The CodecSys software can be applied in any live or on-demand video environment over virtually any delivery platform – whether cable, telco, satellite, wireless, IPTV or Internet streaming," said *Tiede*. "With on-demand applications, content can be pre-recorded and made available as needed."

The Challenge of Internet Video Delivery

Video compression technology is becoming an increasingly critical requirement for video sent over the Internet. Last year, a report from **Nemertes Research** cited in a recent *New York Times* story, video uploading and downloading from sites such as *You Tube*, "consumed as much bandwidth as the entire Internet did in 2000." Most experts agree that a bandwidth crisis looms if new technologies are not developed and implemented to alleviate the congestion.

The bandwidth crisis will be particularly severe in the U.S., which has dropped from fourth to 15th place on the broadband ranking maintained by the *Organization for Economic Cooperation and Development*. *Michael Kleeman*, a senior fellow at the ***Annenberg Center for Communication*** at the **University of Sourthern California**, has cited video compression as a technology critical to the resolution of the bandwidth crisis.

There is no question that better video compression technology would take the pressure off the Internet — especially as more and more users want to upload video to sites like ***YouTube*** and ***MySpace***, in order to share experiences. At present, many content providers are forced to use proprietary streaming solutions that do not solve the fundamental problems associated



VIDEO COMPRESSION USING CODECSYS BASED SYSTEM

with Internet video and thus have unsatisfactory quality. IP networks impose packet loss on data, which can severely impede the quality of a compressed video and audio stream with interdependencies and can impair sound synchronization.

Most current solutions offer only a 25 percent reduction in bandwidth at best, with compromised picture quality. Even new fiber initiatives such as those from Verizon and AT&T will be challenged to deliver the quantity and quality users are going to demand. CodecSys promises a much more effective and longer-range solution, offering bandwidth reductions up to 80 percent, an open software platform for upgrading compression technology, and scalable hardware to accommodate inevitable volume increases.

The Cable Industry... Staying Competitive

Broadcast television and HD video have long been the stronghold of cable companies, but that may well change as IPTV initiatives promise new alternatives to consumers, delivering HD-quality video over newly tooled IP infrastructures. In order to stay competitive, cable providers need to fight back with new and improved services such as more HD programming, Internet gaming, pay-per-view, even social networking, but the cable infrastructure is not up to the task because of inadequate video compression technology.

A recent press release announcing a new report by **CMP** market research group, **Heavy Reading**, states, “surging demand for HDTV, video on demand, time-shifting video services such as digital video recorders, and Internet video is rapidly depleting bandwidth reserves on cable networks and will force cable MSOs to upgrade their networks with new technologies aimed at conserving bandwidth.”

“Solutions such as switched digital video (SDV) are currently being explored by cable providers to address the bandwidth crisis, said Tiede. “SDV is an extremely expensive solution involving change-out of end-user

The multi-blade and multi I/O hardware, combined with advanced MPEG-2 TS software, allows the system to multiplex all the elementary streams onto a single transport stream

devices, and will not address the critical upstream bandwidth issues. It will likely be used with more efficient encoding technologies as well as plant upgrades in order to provide a longer-term solution."

Nexgen video compression technology, such as CodecSys, offers a much more effective and economical solution. Currently, the vast majority of video is delivered at the MPEG-2 standard of 19.4 Mbps. That number needs to come down by nearly 80 percent for live and pre-recorded video to make a real impact on the bandwidth crisis in the cable industry. As CodecSys delivers live HD video at 3 Mbps, it provides this much-needed solution.

Satellite bandwidth space is an expensive commodity. The space that a company leases for transmission of their video content is set and if the company wants to add more channels or wants to add band-width intensive HD channels they have to rent more space which increases their expenses. The other option is to decrease their band-width requirements. The BI CodecSys AVC Encoder/Transcoder using the patented CodecSys technology allows for better compression of video without loss of quality. Better compression means more channels on the same bandwidth or the ability to add HD channels.

Both content providers and satellite service providers can benefit from this. Content providers can expect to transmit more channels on the same bandwidth space, therefore increasing their ROI. Satellite service providers can attract more customers because of a better ROI to their customers and can service more customers on the same satellite space.

About the author

Rod Tiede is the President and CEO of Broadcast International andis responsible for fostering the vision, directing the overall management and providing progressive leadership for the company. Since 1988, Rod has been instrumental in directing the worldwide reach of Broadcast International and his forward-looking strategy has made BI a preferred international technology integrator.

by Chris Forrester, Columnist

On February 5th 1989, just 20 years ago, the *Astra* satellite made its first official transmissions. Astra's major clients were led by an underfunded outfit called Sky Television, which had taken four transponders for its debut service. Other clients came from players such as MTV, CNN, and broadcasters in Germany, Scandinavia, and the Benelux. The Astra satellite had been launched on December 11, 1988, from Kourou, French Guiana, on an *Ariane 4* rocket.

Astra-1A liftoff

It was a massively uncertain time for all concerned. Finding the cash to launch the rocket fell upon *Luxembourg*, a tiny land-locked country. Luxembourg wanted its own satellite, but the plans for ***Luxsat*** had become mired in problems: the country's biggest broadcaster **CLT** (now better known as broadcasting giant **RTL**) was partly controlled by a Belgian investor *Albert Frere* and he was unwilling to take the financial risk that owning a satellite required.

The technical opportunity was that, at this point in the early 1980s, Europe had no high-powered satellites. Secondly, the existing satellites used frequency spectrum called DBS (BSS) which were closely controlled by each country's regulators, often closely aligned with the PTTs — most of which were state-owned. The satellites were each massively expensive and had more than their fair share of technical problems.

Eutelsat had been operating lower-power satellites since 1983, largely to satisfy its PTT clients and had carried entertainment broadcast services like the struggling '*SuperChannel*' since January 1987.

The evolution of the major early satellite TV channels can be easily summarised. 'Sky Channel' had launched in April 1982 as a pan-European largely advertising supported channel. **TEN** (**The Entertainment Network**) launched in March 1984 but went bankrupt a year later, being re-launched as *Robert Maxwell*-owned **Mirrorvision**. Mirrorvision merged with U.K. movie channel ***Premiere*** in April 1986. Premiere closed in 1989. ***Sky Channel***, despite **News Corporation**'s backing, struggled for commercial survival, as did 'SuperChannel', described as representing 'the best of the UK's BBC and ITV archive'. The prognosis was not good.

The ***Astra*** opportunity identified by Luxembourg's then Prime Minister *Pierre Werner* and *Candace Johnson*, the wife of Luxembourg Ambassador *Adrien Meisch*, was to create a commercial satellite company, to buy and launch high-powered satellites and make TV channels from a wide variety of operators available to mass market audiences across Europe. Together they had the connections to get it done: Johnson's father was the American son of General *Johnny Johnson*, who was the head of telecommunications for the American armed forces, and ran telecommunications policy in the White House under Presidents *Johnson* and *Carter*.

Johnson managed to find the not inconsiderable cash support the project needed from a number of sources, including the Luxembourg government, a few Luxembourg banks, and Count *de Kergolay*, a French aristocrat, who stumped up 10 percent of the required, initial US$100 million.

SES's first president after incorporation was *Pierre Meyrat*, a former executive of **Kirch Group**, who would prove instrumental in convincing the German broadcaster to sign up to put channels on the company's first satellite. Kirch Group signed up for three transponders for ***TeleClub***, ***Premiere,*** and ***Sat1***. However, once RTL president *Goost Graas* heard that Kirch had signed did RTL

British Satellite Broadcasting, which lost some $3bn before being absorbed by Murdoch's Sky TV.

make a move — they signed at midnight to have several of their own channels on Astra.

The upstart satellite company got another important fillip when it signed Rupert Murdoch to four transponders for his fledgling Sky TV service in the U.K. The deal with Astra was one of keys to making Sky the winning operator over the direct-to-home proposition in the U.K., buying out its rival **BSB** in late 1989.

Listing this litany of facts doesn't begin to tell the challenges of the entire story, of the political intrigue in Germany, France, and the U.K. over this new competitor to the cosy world of PTT-controlled satellites. Satellite also threatened to upset the world of cable, as well as formally licensed operators (such as **British Satellite Broadcasting** which was seriously endangered by 'new boy' Murdoch, and would be taken over by Sky in November 1990). The expenditure on satellite was truly ruinous for BSB, which lost almost £2bn ($3bn) during its short life.

Rupert Murdoch and **News International**, by buying Sky Channel and converting it into a four-channel service (it ought to have been five, but **Disney** didn't join the service at first), created the largest group of channels in Europe.

Sky Channel was Europe's first satellite TV channel, launched in April 1982. In 1983, News International bought 65 percent of its shares and, by 1988, owned 82 percent. In 1987, Sky increased its capitalisation by raising 22.63 million pounds, but its losses to that point in time (and subsequently) were substantial. By the end of its 1987-88 financial year, it had lost nearly 39 million pounds. That was bad, but by 1991, the losses were a massive 759 million pounds, on revenues of just 93 million pounds.

SES Astra's control room

The following year revenues grew to 233 million pounds, but losses topped 188 million pounds. ***BSkyB*** eventually moved into profit during its 1994 trading year, which generated 550 million pounds in revenues and profits of 93 million pounds. Today's figures are somewhat more healthy, and their 2007 trading year (to June 2008) realized revenues of 4.95 billion pounds, and operating profit of 752 million pounds.

Let's get back to satellite and the arrival of Astra. In 1983, a somewhat percipient Luxembourg government had taken the bold decision to enter the 'satellite age'. SES Astra's early publicity extolled the Brussels-backed message of '*Television Without Frontiers*', and encouraging entrepreneurship in a 'new age' of TV.

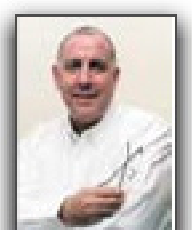
A historic photo of Rupert Murdoch with Astra pioneers Dr. Pierre Meyrat and Marcus Bicknell

However, at the time of the ***Astra-1A*** launch, the potential market for existing *direct-to-home* (**DTH**) satellite reception was minuscule — no more than 113,880 installations across Europe. Although designed as a telecommunications rather than a broadcasting satellite, it was the vehicle that enabled many more viewers to access satellite TV with low-cost receiver boxes and small satellite dishes. Up to this point, viewers had needed dishes of at least 90 cm diameter (and ideally 1.2 metres) to obtain an acceptable screen image.

Naturally enough, Astra had to present its own forecasts to the financiers and in 1987 it suggested that by 1996 (thereby, 10 years hence), it would be reaching 20.2 million DTH and SMATV homes over Europe, and more again by cable. The reality was quite an improvement on the original forecasts, at 22.97 million homes, ahead of SES's own estimate. *Marcus Bicknell*, who was SES's first Marketing Director, and is now a main board director at SES, admitted that his forecasts had initially been perceived as optimistic, and confirms that they were based on the take-up and ownership of VCR's in any given market.

Since those early days, Astra has grown in strength and diversity, and has pay and free-to-air television over Europe. Astra, or more correctly the **Societe Europeenne des Satellites**, now controls **SES New Skies** as well as **SES Americom**. Its European footprint includes 107 million viewing homes (via DTH, cable and SMATV). Europe now has about 6,000 TV channels. The U.K. is home to more than 861 channels (many being beamed into Europe and elsewhere). A huge industry has been created — and it all started 20 years ago.

About the author



London-based Chris Forrester is a well-known entertainment and broadcasting journalist. He reports on all aspects of the TV industry with special emphasis on content, the business of film, television and emerging technologies. This includes interactive multi-media and the growing importance of web-streamed and digitized content over all delivery platforms including cable, satellite and digital terrestrial TV as well as cellular and 3G mobile. Chris has been investigating, researching and reporting on the so-called 'broadband explosion' for 25 years

Executive Spotlight On...

Paul Dujardin
Founder, President, CEO, Director
Genesis Networks

Paul founded Genesis Networks in 2001 and developed and implemented the business strategy for global products. He has more than 35 years of experience in the Video and Telecommunications industries and founded Triumph Communications in 1993, a Video-over-Asynchronous Transfer Mode ("ATM") provider, serving as President until its sale to Liberty Livewire in 2000 for $54 million. Triumph Communications designed and implemented the first all-digital dedicated network for CNN, and a local Television backhaul fiber network for DirecTV. Mr. Dujardin worked for broadcast and transmission services company IDB Communications from 1989 to 1993 as Vice President of Sales and Product Development. During his tenure, he developed an industry-standard switch center, which enabled Video connectivity for local customers. While working for Teleport Communications (then a company of Merrill Lynch) from 1984 to 1989 as Director of Sales, he developed their media industry business segment and introduced the first fiber digital video network in the New York City metro area. Paul implemented the first compressed video service with a 45 Megabit transfer rate, which was used by ABC News' Nightline broadcast. Mr. Dujardin was President of Mizlou Television Network, an early syndicator of television sports in the U.S., from 1981 to 1984. Prior thereto, he was the Manager of Broadcasting for AT&T from 1971 to 1981, where he created the first Video switching service (AVOC switch) for CNN in Washington, DC.

SatMagazine
What are some of the biggest issues facing companies and organizations that depend on satellite communications?

Paul Dujardin
With the explosive growth and high bandwidth requirements of HD programming, it's getting harder for broadcasters and cable distribution companies to find and book the satellite capacity they need. Likewise, satellite providers are having an increasingly difficult time meeting demand. Short of launching more satellites into orbit, these companies are searching for cost-effective and viable alternatives to satellite transmissions — and that's where fiber networks come in.

Military organizations have relied heavily on satellite communications for decades, but they're also looking for alternatives, especially given the growing scarcity of bandwidth. It simply isn't practical to connect two relatively close locations with a 23,000-mile satellite hop, and there are security concerns with satellite, as well.

SatMagazine
How do fiber optic networks overcome these challenges?

Paul Dujardin
Satellite will continue to be the best option for the point-to-multipoint transmissions of cable distributors, but terrestrial fiber is often superior in point-to-point situations; for instance, a content owner that needs to deliver an HD feed from its headquarters in Sydney to a media distribution hub in New York. In many cases, a transmission that might have required multiple satellite hops before can now be accomplished with a single fiber link, at a lower cost and with higher quality and reliability. Besides relieving some of the pressure on the overburdened satellite system, fiber offers broadcasters greater flexibility for any type of transmission, whether they need a full-time service or a one-time connection for a short-duration broadcast such as a sports event.

As fiber doesn't yet reach into every corner of the Earth, a hybrid satellite-fiber approach can offer the best of both worlds for bringing signals out of far-flung locations. Take the example of a military operation that is transmitting from a remote site. The signal can be uplinked to a satellite for the "first mile" of transmission, where it can be downlinked and then handed off to a terrestrial fiber network for international delivery.

Fiber offers another plus that's especially attractive to the military: enhanced security. It's not too difficult for just about anyone to pull a signal down from a satellite transmission, but since our fiber network is highly managed, a signal can't be intercepted and demodulated without setting off numerous alarms.

SatMagazine
What prompted you to found Genesis Networks?

Paul Dujardin
Throughout my career, I've worked on taking new and emerging technologies and developing them into commercially viable media transmission systems for companies such as AT&T Broadcast Services and Merrill Lynch. While I was building a teleport communications service for Merrill Lynch, I was approached by IDB Communications to help them expand into video transmission. Although IDB was very satellite-centric, I began to realize the possibilities of fiber for global communications.

In 1993 I started **Triumph Communications** to perfect video over ATM fiber for telco companies, which was about the time satellite broadcasters such as Directv and Echostar were getting started. At that time, DirecTV was having difficulty retaining customers because it couldn't provide local television, so we became DirecTV's exclusive provider of local TV signals via ATM fiber.

By the millennium, we had built a significant network within the United States, serving large customers such as DirecTV and CNN, and I had an opportunity to sell the company to Liberty Media. About that time, large-scale deregulation was taking place in Europe, which offered a prime opportunity to develop a fiber network there. As a result, we launched Genesis Networks in September of 2001 with the goal of becoming the premier provider of global video over IP.

SatMagazine

Why has Genesis Networks been so successful in delivering on the promise of fiber optics?

Paul Dujardin

The fiber network we've built — with almost 200 points of presence all over the world, has been truly game-changing in terms of how major media organizations gather and distribute news. As a result, we've attracted a lot of attention in the industry and some very high profile customers, such as BBC News, APTN, and CNN. The ubiquity of our network, combined with our hybrid satellite-fiber service, SABER, means that these companies are able to bring high-quality news feeds out of even the most remote locations reliably and cost-effectively.

Another large selling point for our network is our IRIS software service, which allows broadcasters to control their own transmissions. With IRIS, customers can instantly book feeds out of any location and monitor their transmissions from anywhere by accessing the IRIS Web site. No other network service actually places this much control in the hands of customers.

We're also receiving a lot of attention with our services to DTH platforms, which represent the fastest-growing segments of the media industry. DTH companies recognize that there's a huge market opportunity to deliver ethnic programming to expatriate communities in North America, Europe, and other parts of the world; for instance, the large population of India natives living in Canada.

The challenge for DTH platforms is to gather this ethnic programming from its country of origin and deliver it cost-effectively without multiple satellite hops. With fiber, these companies are able to reduce their transmission budgets by as much as 50 percent. Another tremendous advantage of fiber over satellite is that it enables commercial content to be localized for the region in which the content is to be broadcast, which creates a solid new revenue stream.

SatMagazine

What do you believe are the biggest opportunities for Genesis Networks over the next five years?

Paul Dujardin

Without question, the explosion in demand for ethnic programming and the need for media companies to deliver it to HD and DTH platforms all over the world will continue to drive our business for years to come. Our commercial insertion service, which enables customers to localize advertising and build revenue with the destination demographic, is a large component of our business.

Another growth area for us is the realm of streaming video for mobile devices; more specifically, delivery of ethnic programming to video phones. Mobile providers have many of the same challenges as the DTH platforms in that they have a large opportunity here but limited resources for gathering and aggregating the content. We can gather the programming from its source via fiber and stream it to the mobile operator. In the military arena, we see a large opportunity for training applications.

This goes far beyond video conferencing and involves connecting bases with contractors via fiber for high-end, HD presentations and training on design and research. We could provide a highly secure and budget-friendly environment in which defense contractors working with the Pentagon and key military organizations could discuss design, status, and workmanship of various projects in the works.

by Michael L. Downey, Patricia Constantino, and Jeffrey C. Chu, Glowlink Communications

Satellite interference is a growing problem that affects all commercial satellites and satellite users. One underlying cause is the large number of transmit antennas now pointed to these satellites, including the ubiquitous VSAT. As the number of transmitters has increased, so has the number of interference events.

Damages caused by interferences range from disrupted traffic to lost revenue and unusable bandwidths. Among satellite users, one of the most vulnerable is video broadcasters. This is due to the sheer size of video signal bandwidths, which often span an entire satellite transponder. Video broadcasters may also find their signals share the same beam or polarization with hundreds or even thousands of other users. Such results in increased chances of their signals being adversely affected by interferences.

The trend of more frequent interference events is coming at a time when *fixed satellite service* (**FSS**) providers have been going through major consolidation to gain operational efficiency. This consolidation has resulted in larger fleet sizes for the surviving FSS providers, increased customer population, and higher service demand that, if improperly managed, can significantly add to or even overwhelm the work load of FSS customer service centers, resulting in lower quality of support.

Because of these trends, FSS providers, such as **Intelsat**, have been aggressively improving the efficiency and productivity of their service centers by adopting tools and best practices for three crucial network management functions

- *spectrum monitoring*
- *interference detection*
- *geolocation*

Simultaneously, more satellite users, including video broadcasters and government organizations, are also taking on an increasingly proactive role in ensuring the integrity and security of their own satellite traffic, often with the same type of tools and best practices.

In this article, we discuss the advances in technology that can now allow a single system to perform the functions of spectrum monitoring, interference detection and geolocation in a seamlessly integrated, cost-effective way. This level of integration and convergence of technologies has helped create tools that are highly automated, labor-saving, and surprisingly affordable.

Categories of Satellite Interference

The causes of satellite interference generally fall into one of three categories...

- *human action*
- *equipment malfunction*
- *frequency spectrum*

Interference caused by humans can be intentional and unintentional. Examples of intentional interference include rogue users who are pirating bandwidth or intentionally performing malicious jamming. Examples of unintentional interference include accessing the wrong satellite, coming up on the wrong polarization or transmitting at an incorrect frequency. Interference caused by human error is generally accidental and can often be quickly resolved, especially in cases where the access is being assisted by a satellite controller. Intentional interferences are generally harder to eradicate.

Interference caused by equipment malfunction has been on the rise over the last decade. As mentioned earlier, the root cause of this is the dramatic increases in the number of transmit capable antennas deployed worldwide, in particular, small VSAT terminals equipped with low-cost outdoor equipment. Many of the interferences seen on commercial satellites today are caused by some sort of ground equipment malfunction.

Interferences caused by frequency spectrum issues are also on the rise. As the demand for spectrum increases along with the number of new communications services being offered, the competition for available spectrum is intense. Satellite transmissions can be impacted by a variety of terrestrially based interference sources. Examples include terrestrial wireless services, line of sight microwave and various radar systems.

Dealing with Satellite Interference

The process of resolving satellite interference problems generally involves the following four steps: ***(1) Interference Detection***; ***(2) Interference Classification***; ***(3) Interference Isolation***; and ***(4) Geolocation***.

Interference Detection

The first step in the process is to reliably detect interference when it occurs. This is accomplished by using a modern DSP based spectrum monitoring and interference detection system, such as the ***Glowlink Model 1000*** (*Figure 1, shown with touch-screen*). The Model 1000 can be used to tightly manage transponder bandwidth and can be configured to detect even the weakest interferers.

Photo courtesy of Glowlink®

Figure 1— Glowlink Model 1000 DSP-Based Monitoring and Interference Detection System

Advanced signal processing techniques in the Model 1000 can detect both interferences that show up in unused bandwidth, as well as interferences that are hidden within the bandwidth of another traffic signal (***Figure 2***). This technology, known as *Signal Under Carrier* (***SunCar***™) and pioneered by Glowlink, has been adopted by nearly all customers in their carrier monitoring systems.

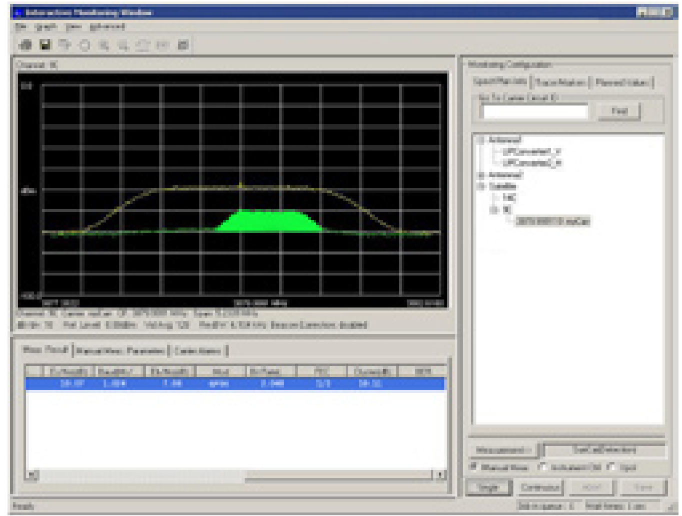


Image courtesy of Glowlink®

Figure 2 — Detecting and Characterizing Hidden Interference Signals

A unique but interesting aspect of the SunCar™ technology is that it can also be used to separately measure two carriers with identical power, carrier frequency, and data rate. This means it can be used to monitor fully overlapping "paired" carriers, a new transmission technology used in various bandwidth-efficient modems on the market. This type of transmission conserves bandwidths, but amounts to self-interferences from a spectral perspective. ***Figure 3*** shows two such signals that appear spectrally as one carrier, yet individually measurable by the Model 1000 with results shown in the report panel.

Tools such as the Model 1000 can also separate interference from other anomalies that may cause receive performance degradation. For example, phase jitter, uplink compression, adjacent channel interference, transponder compression or in-band interference can all cause a signals received Es/No performance to deteriorate. By isolating the problem to interference, the Model 1000 can dramatically improve the productivity of trouble-shooting.

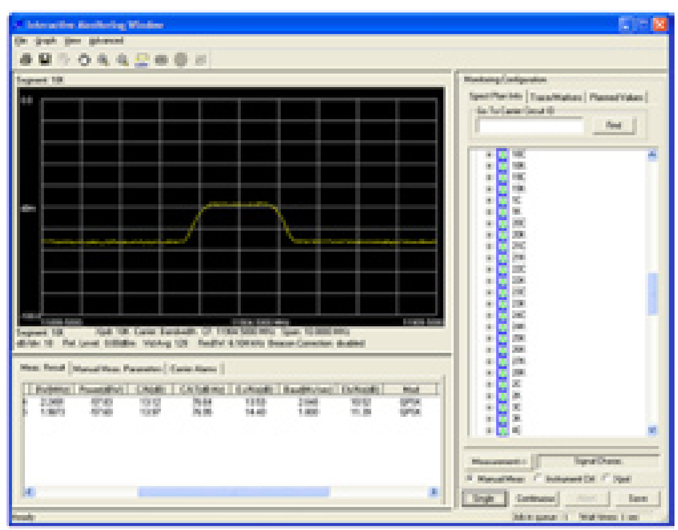


Image courtesy of Glowlink®

Figure 3 — Monitoring and Reporting for Overlapping "Paired" Carriers

Interference Classification

In addition to being able to reliably detect interference, a versatile monitoring tool like the Model 1000 can also assist the operator in classifying and in turn isolating what causes the interference. Classification generally involves determining the characteristics of a particular interference signal: classifying the interference as stationary or non-stationary, such as misplaced communications carriers, spurious signals, and fixed noise mounds, or sweeping signals, bursting signals, hopping signals or various forms of intermittent signals. There are now available on the market various data fusion tools such as those built into the Model 1000, which can simplify this process.

Interference Isolation

Isolation is the third step in the process whereby the source of the interference is determined. Once interference has been detected and classified, tools such as the Model 1000 can help the satellite operator further identify the interference in terms of sweep rate, burst rate, burst interval, or modulation related parameters. In many cases, such signal "DNA" is sufficient to quickly identify and remove the source of the interference. The Model 1000 also has various built-in tools to help operators resolve common interference problems, including cross-pol bleed over, adjacent channel interference, and misplaced but otherwise legitimate carriers.

Geolocation

When a satellite interference cannot be resolved using the above process, it is necessary to perform geolocation, defined as the process whereby the interference emitter is located so appropriate action can be taken.

How Geolocation Works

When an interfering emitter transmits to a satellite, a small fraction of its energy illuminates adjacent satellites via the sidelobes of the transmitting antenna

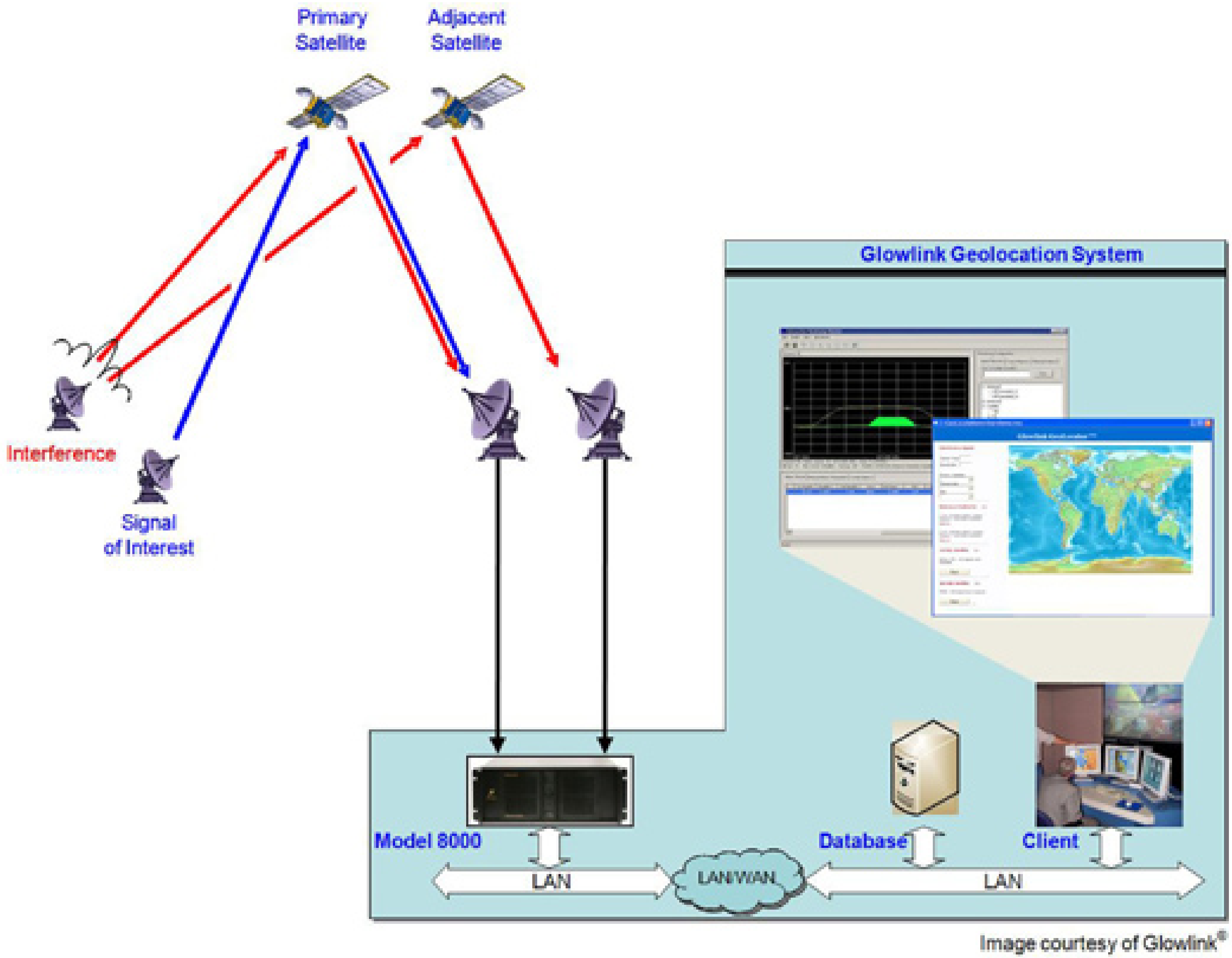


Figure 4 — Exploiting Antenna Sidelobe Spill-Over to Geolocate Interference Signals

(*Figure 4*). Geolocation exploits this tiny bit of spilt-over energy to make time and frequency difference measurements of the interference signal as it passed through the primary or "affected" satellite and one or more adjacent satellites. Making these measurements can be extremely challenging, however.

A system that can perform this type of measurements where the signals differ by a factor of 10,000—commonly referred to as 40 dB--is generally considered marginal. Systems where measurements can be achieved for a factor of 100,000 or better are more dependable.

Geolocation works by making relative measurements between satellite pairs and combining these measurements with the ephemeris of the satellites to locate the unknown emitter on earth. The relative measurements include *time difference of arrival* (**TDOA**) and *frequency difference of arrival* (**FDOA**). These measurements translate to lines of position on earth where the emitter could be located. The intersection of two such lines then forms an estimate of the interferer's location.

Geolocation solutions may be formed by intersecting two TDOA lines, two FDOA lines or one TDOA and one FDOA line. Intersections of two TDOA or two FDOA lines requires measurements from two pairs of satellites whereas an intersection of one TDOA line with one FDOA line can be accomplished from a single pair of satellites (***Figure 5***).

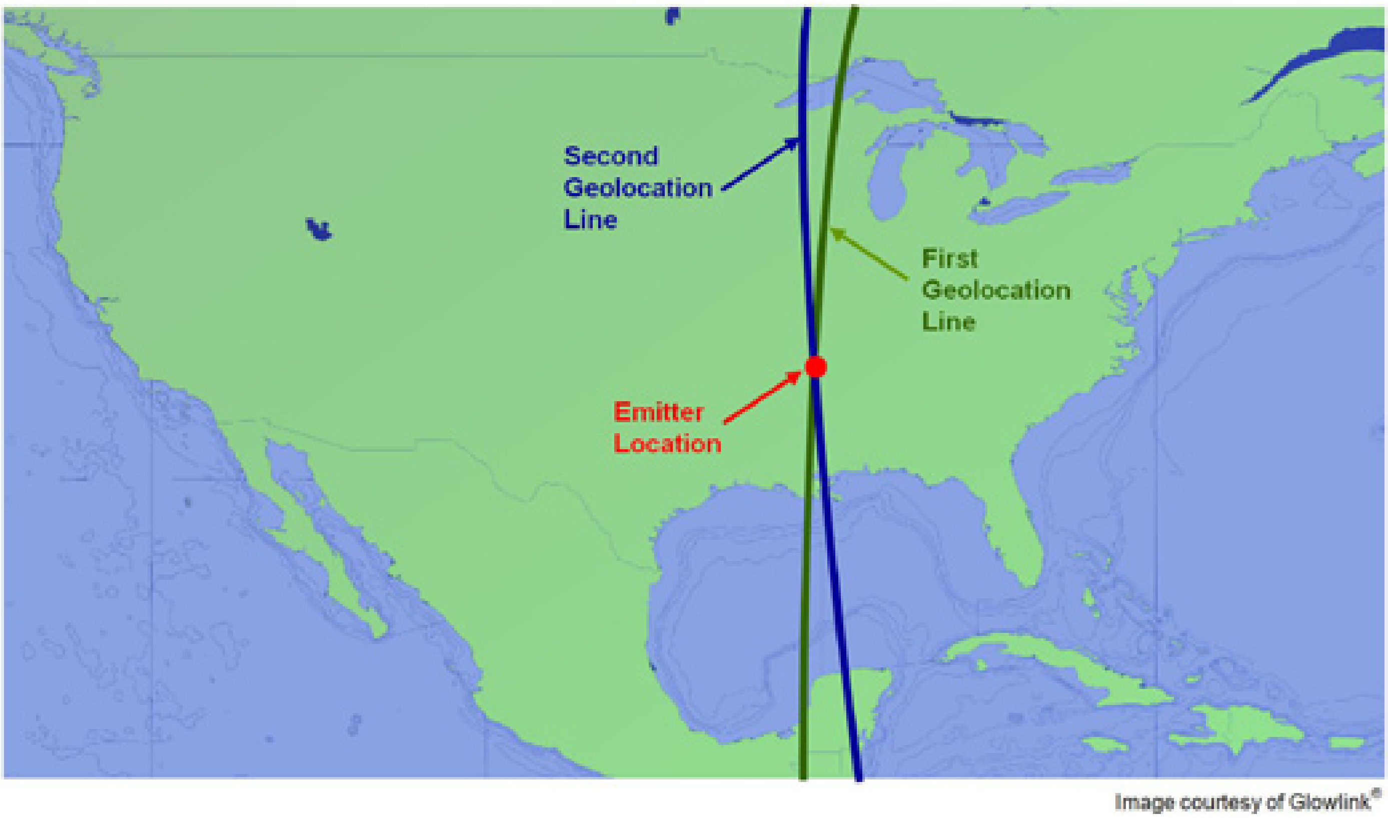


Figure 5 — Geolocating The Transmit Emitter Location

There are differences between these techniques that can affect the performance of a geolocation system. The next few paragraphs examine these differences.

Properties of TDOA Measurements

TDOA measurements between a pair of satellites hinges on determining the difference in path length from the emitter's location on earth to the primary satellite and the adjacent satellite. A key advantage of this approach is that it is independent of signal frequency, and therefore equally effective from UHF to Ka. However, measuring these time differences is extremely challenging and only a geolocation system that is properly designed will work correctly.

Another important factor of an effective system is the ability to perform fast signal acquisition in order to deal with hoppers or fast sweepers. The TDOA approach lends itself naturally to these types of interferers.

FDOA measures the differences between frequency Doppler shifts between a pair of satellites relative to the interference emitter. Two things are immediately obvious: First, unlike TDOA, FDOA measurements are frequency dependent. For geolocation, this means that the observed Doppler shift shrinks as the frequency band goes from Ku to C, making it harder to measure. Second, geostationary satellites in general do not move much, making Doppler even smaller. For a significant number of geostationary satellite pairs, there is little Doppler shift even at Ku band.

As the *Doppler* shift on geostationary satellites can be as small as a hundredth of 1 Hz, a geolocation system using FDOA technique must acquire the signal for a relatively long duration (> one minute) and over a relatively narrow bandwidth to yield sufficient samples for processing. Because of these constraints, FDOA, while suitable when there is large satellite motion and stationary signals, can often be rendered ineffective, especially against increasingly common interferences such as frequency sweepers or bursting signals.

Properties of TDOA-TDOA Solutions Versus TDOA-FDOA Solutions

As mentioned earlier, intersections of TDOA lines, FDOA lines or a combination of both TDOA and FDOA lines can yield an emitter location. One intrinsic property of the TDOA lines approach is that it does not

Figure 6 — Glowlink Model 8000 Integrated Geolocation System

change shape or orientation over time, thereby allowing geolocation to be performed any time of the day. In contrast, FDOA lines are constantly changing orientation during a day. This has the effect of producing highly inconsistent results, and therefore is effective only during certain times of the day when the intersecting lines are nearly orthogonal. Unfortunately, the interferer cannot always be expected to be cooperative enough to appear in these desirable time windows!

Available Tools on the Market

One geolocation system on the market that is optimized for performance under various constraints is Glowlink's ***Model 8000***. The Model 8000 is the world's first fully integrated spectrum monitoring, interference detection and geolocation system in a compact 4U chassis (Figure 6). The system is also priced to be affordable for almost everyone in the satellite business, not just large customers with large capital equipment budgets.

Due Diligence = A Viable Solution

Because of the growing problem of interference and the increasing complexity of interfering signals, the satellite community needs effective and affordable tools to help them detect, identify, and remove these interferences. There are many products on the market with various degrees of effectiveness and attributes, Potential buyers of these systems must do their due diligence and insist on equipment demonstration, performance evaluation, and customer references, as well as considerations such as pricing, system attributes, and equipment reliability.

About the authors

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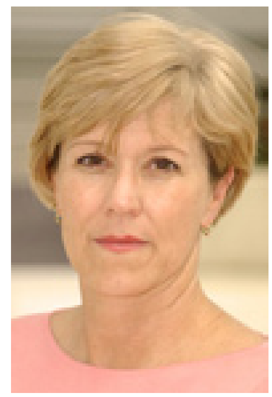


Patricia Constantino is the Director, RF Operations Center, Intelsat. Ms. Constantino has more than 30 years of organizational knowledge, technical expertise, and leadership experience in satellite and telecommunication services. At Intelsat, Ms. Constantino has spearheaded the effort to consolidate, modernize, and improve the efficiency and productivity of its RF operations center for the world's largest satellite fleet.

Jeffrey C. Chu is the co-founder, Chairman and CEO, Glowlink Communications Technology, Inc. He has extensive experiences in satellite communications monitoring and control, having co-invented and managed the first generation of such systems for the United States government. Mr. Chu received his Bachelor of Science degree from Harvey Mudd College, and his MSEE from the University of California, Berkeley.

The SmallSat Urge To Merge...

by John Stone, Near Earth LLC

As we detailed last month (see [*Satellites Going Bigger Or Smaller? Yes!*] in the *January 2009* issue of *SatMagazine*), the market for satellite systems is broadening, leading to growth in demand for large as well as smaller satellites.

While the trend for increasing power levels for commercial satellites (a direct driver of their size) towards and beyond 20 kW has been around for some time, the expansion of demand for smaller satellites is a relatively new phenomenon. At the same time, this expansion of demand for small satellites has been mirrored by an expansion of demand for small satellite companies. Consider the transactions listed on ***Page 36.*** Quite apparently, capital has been chasing the small satellite industry. ***But why?***

One reason is the expanding capabilities (and thus the expanding market) of small satellites – as detailed last month. With the market for larger space systems growing more slowly, smallsats offer a way for these larger firms to reignite their growth, and thus investor interest. While part of the reason is clearly the growth in the market for the product and technical capabilities of the companies themselves, we think another force is also at work here.

The answer lies in looking at the acquirers – typically large companies that have other space systems capabilities – but have few or no small satellite offerings. While this could be thought of the classical build vs. buy scenario, where buying is cheaper, we think that is too simple.

Rather, we note that most of these small satellite firms are not only focused on a developing market niche, but are developing companies themselves – that is, they are young firms. As important as their technical capabilities

	RapidEye	GeoEye
Size	5 satellites	1 satellite
Mass per sat	150 kg	1955 kg
System costs	€160 million	$209 million

	ORBCOMM	iridium	inmarsat
System	Orbcomm	Iridium	Inmarsat-3
Size	28 satellites	66 satellites	5 satellites
Mass per sat	45kg	689kg	2068kg
System costs	$330 million	Approx. $6 billion	Approx. $1 billion
Subscribers	420,000	305,000	235,400
Revenues (m)	27.2	312.0	623.2
ARPU	$64.76	$1022.95	$2647.41
EBITDA (m)	(2.5)	107.0	435.4

are, we think their "start up" cultures, wher costs are very closely monitored and controlled by necessity, are also attractive to acquirers.

To some extent, this mimics the situation at **SpaceX**, where the same sort of culture has resulted in drastically lower costs. The key will be to see the extent that these firms can remain entrepreneurial as they are incorporated into their larger parents.

From the perspective of these parents, when considering entering the sector one needs to have this cultural advantage to compete – but it is virtually impossible to create from scratch. Acquisition becomes the only real way for them to address this growing market opportunity.

Of course, from our perspective as bankers to the sector, the question arises: what next? If past experience is any guide, we expect this trend to continue. With ten or so remaining smallsat companies out there, and today's market conditions that make it difficult to fund smaller private companies, we think the trend will not just continue, but accelerate.

Target	Acquirer	Year
Spectrum Astro	General Dynamics	July 2004
Swales Aerospace	ATK	June 2007
AeroAstro	Radyne	August 2007
Alliance Spacesystem	MacDonald Dettwiler	December 2007
Microsat	Sierra Nevada	January 2008
Surrey Satellite	EADS	April 2008
SpaceDev	Sierra Nevada	October 2008

by Lance Griffiths, Ph.D., Radome Design Engineer, MFG Galileo Composites

The basic function of a radome is to form a barrier between an antenna and the environment with minimal impact on the antenna's electrical performance. Under ideal conditions a radome is electrically invisible. How well a radome accomplishes this depends on matching its configuration and materials composition to a particular application and RF frequency range.

Radomes can be found protecting a wide range of outdoor terrestrial and shipboard communications systems and radar installations as well as airborne avionics antennas. The proper selection of a radome for a given antenna can actually help improve overall system performance, by:

- *Maintaining alignment by eliminating wind loading;*
- *Protection from rain, snow, hail, sand, salt spray, insects, animals, UV damage, and wide temperature fluctuations for all-weather operation;*
- *Providing shelter for installation and maintenance personnel;*
- *Preventing visual observation of system (security); and minimizing downtime, and extending component and system life.*

Today's ground and ship-based radomes are manufactured using composite materials such as fiberglass, quartz, and aramid fibers held together with polyester, epoxy, and other resins such as the one shown in ***Image 1***. (This is an installed **MFG Galileo Composites *Generation II*** radome featuring non-symmetric geometric panel configuration and an impedance-matched bolting seam). Foam and honeycomb cores are often added between inner and outer "skins" of the radome to function as a low-dielectric-constant spacer material providing structural strength and rigidity.

Image 1

It is important that the dielectric constant of the material is low to reduce reflections, thus minimizing impact to the radiation pattern and insertion loss. Some materials such as **UHMWPE** and many plastics have a dielectric constant close to 2. However, requirements such as high strength, high operating temperature, or low cost preclude them in many cases.

Understanding RF Reflections

Radomes are generally made of dielectric materials which are characterized by their dielectric constant, loss tangent, and various other electrical parameters. Dielectric materials have a characteristic impedance of

$$Z_D = \frac{377\Omega}{\sqrt{\varepsilon_r}}$$

where ε is the dielectric constant relative to free space. The impedance of free space is

$$Z_{FS} = \sqrt{\frac{\mu_0}{\varepsilon_0}} = 377$$

When an electromagnetic wave in free space impinges upon a dielectric material at normal incidence (as shown in ***Image 2 below***.)

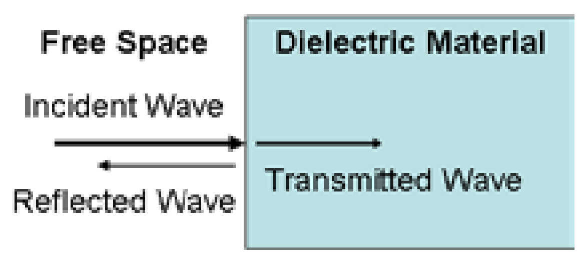


Image 2

The reflection coefficient is

$$= \frac{Z_D - Z_{FS}}{Z_D + Z_{FS}}.$$

As Z_D is less than Z_{FS}, the reflection coefficient Γ is negative, which means reflected wave is 180° out of phase with the incident wave. When the wave hits the free space boundary on the other side of the dielectric, the numerator reverses and

$$= \frac{Z_{FS} \quad Z_D}{Z_D + Z_{FS}}.$$

Radome Configurations Reviewed

Several radome configurations are used to minimize RF reflections, including electrically thin, half-wave, A-sandwich, C-sandwich and others. The best configuration for a particular application depends on the mechanical requirements and operating frequency.

A radome that is electrically thin (less than 0.1 wavelengths), as shown in ***Image 3,*** will generally deliver good RF performance. This is because signal reflections at the free-space/dielectric boundary are cancelled out by out-of-phase reflections from the dielectric/free space boundary on the other side of the dielectric material.

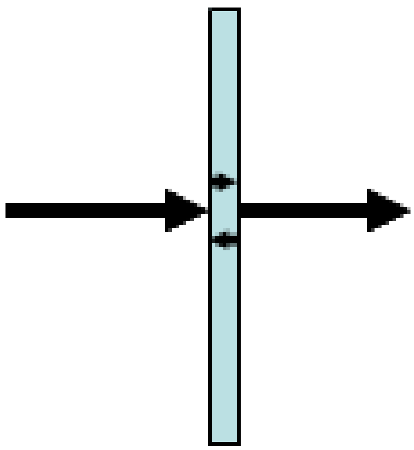


Image 3

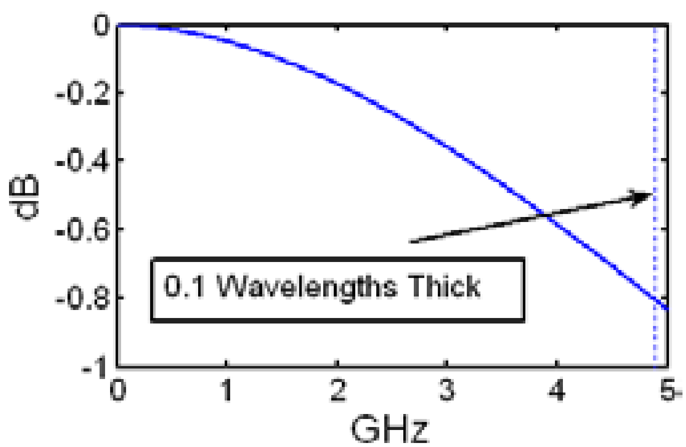


Image 4

Image 4 shows that signal losses are low and the net transmission from an electrically thin dielectric laminate is very high. Unfortunately, electrically thin radomes provide very little thermal insulation and are not suitable for locations with wide temperature extremes and a requirement for controlled temperatures.

Another approach that works well is a configuration based on the half-wavelength-thick solid laminate shown in ***Image 5***. It is similar to the electrically thin configuration because the reflections cancel out. The wave travels 180° through the laminate, is reflected with a phase shift of -180°, and travels another 180° on the return trip to achieve the net 180° phase shift required for cancellation.

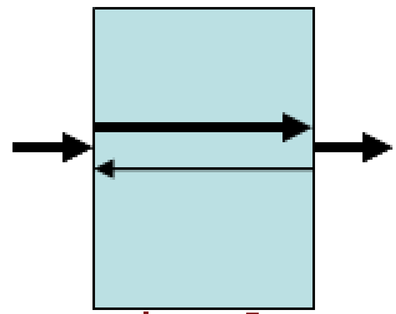


Image 5

Image 6 shows the performance of the same laminate described in ***Image 4*** at higher frequencies (through 35 GHz) where it is 0.5 wavelengths thick.

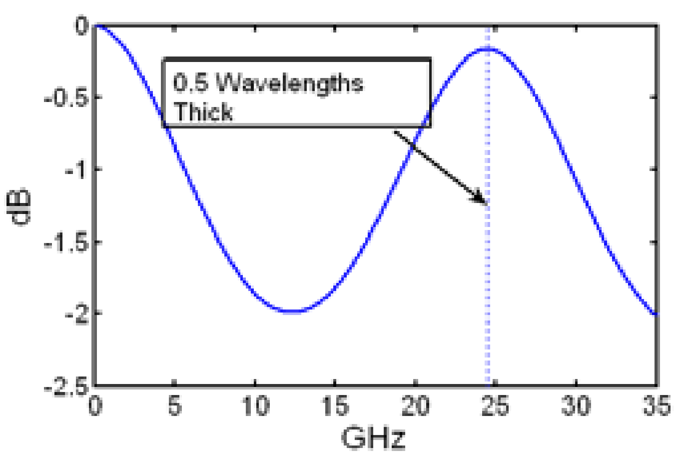


Image 6

An A-sandwich radome configuration consists of a low dielectric foam or honeycomb core sandwiched between two thin laminates as shown in ***Image 7***. Its operation is similar to the half-wavelength-thick solid laminate. However, it is 0.25 wavelengths thick because the reflection coefficients from the skins have the same amplitude and phase. The round trip for the reflection from the second skin is 0.5 wavelengths. The reflections, which are 180° out of phase, cancel (***Image 7***).

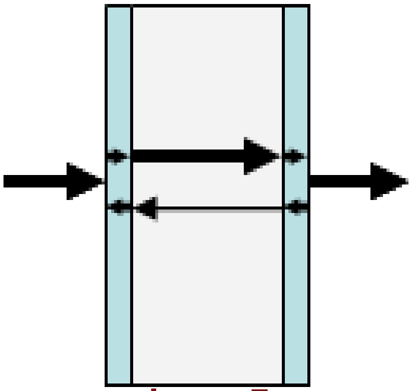


Image 7

Image 8 reveals reflections of an A-sandwich radome plotted versus frequency. The foam core is designed to be 0.25 wavelengths at 5 GHz, which provides maximum performance at <7 GHz (and 15 GHz where the phase shift is an odd multiple of 180°).

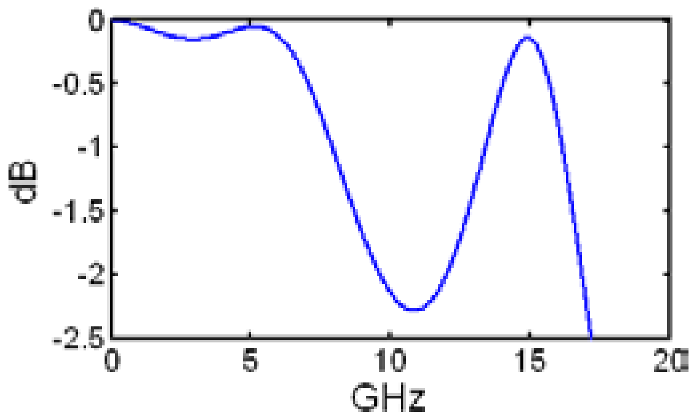


Image 8

A C-sandwich radome consists of three skin layers and two foam layers as shown in ***Figure 9***. The thickness of each foam layer, and possibly the skins, can be tuned for optimal RF performance in the bands of interest. This can lead to many potential construction combinations that can provide good RF performance and high mechanical strength. C-Sandwich constructions provide better performance than A-sandwich radomes; however, the added complexity increases material and labor costs.

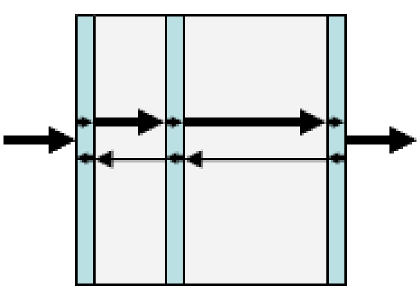


Image 9

Structural Support

Although radomes are used extensively on airframes and missiles, this section focuses specifically on support structures for terrestrial and shipboard systems. Ground and shipboard radomes can range in size from very small antenna covers to massive structures tens of meters in diameter. There are many methods to support the structure, each with strengths and limitations summarized in ***Table 1*** on the next page, which show featuers and drawbacks of radome support configurations.

Self-supporting radomes are usually based on an A-sandwich configuration. They are made of rigid sections that are bolted or latched together. If phase delay and insertion loss through the seam is matched to the rest of the radome, the seam becomes largely invisible to the electromagnetic wave front. Unlike other radome types mention in this article, A-sandwich radomes require no air blowers to maintain pressure and are not dependant on electrical power for electro-magnetic or structural performance. A-sandwich radomes generally have lower overall operation and maintenance costs.

Inflatable radomes are made of electrically thin dielectric cloth. Being electrically thin, they can achieve very low loss over wide bandwidths. The tradeoff for high performance is that they require a constant supply of air, supplied by air blowers or air compressors from inside. They also require airlocks at all doors and a stand-by power supply to operate the blowers at all times and under all environmental conditions. Should the membrane suffer damage or if power is interrupted the radome can potentially collapse. Operating and maintenance cost for inflatable radomes usually exceeds all other types.

Metal space frame radomes support the window portion of the radome consisting of the electrically thin, half-wave, or A-sandwich configuration - often in the shape of a geodesic dome. The window portion typically has very low loss, however signal blockage from the frame reduces system gain and reflects noise back into the system. Because the frame reflects and refracts the RF wave front, it increases sidelobe levels. A method used to prevent large sidelobes is the use of a quasi-random frame pattern.

Table 1: Features and drawbacks of radome support configurations

	Features				*Drawbacks*		
Radome Type	Can withstand >150 MPH winds	Electrically thin broadband performance	Tuned multiband performance	Provides thermal insulative properties	Requires constant positive pressure	Support frame adds significant loss	Notes
Self Supporting Sandwich	X		X	X			
Inflatable	X	X			X		
Metal Space Frame (MSF)	X	X	X		X*	X	
Dielectric Space Frame (DSF)	X	X	X		X*	X	Insertion Loss Ripple above 1 GHz
Solid Laminate	X			X			Single Band Tuning

* *Thin fabric membrane radomes need positive pressure to prevent damage in high wind conditions.*

In contrast to metal space frame radomes, dielectric space frame radomes are supported with members that are somewhat electrically transparent. However, the wave front is phase-delayed as it passes through the dielectric support, alternating between in and out of phase, depending on frequency. If the delay is 180° out of phase with the incident signal, the energy that passes through the frame subtracts from the gain. This leads to a frequency dependant sinusoidal ripple in the insertion loss and the lost energy goes into the sidelobes. Consequently, these radomes are best for systems that operate at less than 1 GHz.

Both types of space frame radomes usually require air blowers or compressors for the structural integrity of their thin membrane coverings during windy conditions. Failure to maintain positive pressure can result in membrane damage and failure.

Impact of Incident Angle

All of the plots and explanations thus far show reflections at normal incidence. Typically, an electromagnetic wave hits the radome surface at an oblique angle, or in the case of a spherical radome, a continuous range of oblique angles. The transmission characteristics of the radome change with the wave incidence angle and polarization. Electric fields that are parallel to the plane of incidence have much higher transmission than fields that are perpendicular to the plane of incidence.

Aerodynamic radomes used on aircraft and missiles often see high incidence angles. This can result in large amounts of axial ratio degradation for circularly polarized antennas and higher insertion loss. Electromagnetic wave fronts from parabolic antennas located inside spherically shaped radomes see low incident angles at the center of the wave front. Out on the edges, however, the incident angle becomes higher. If the antenna illumination pattern is symmetric, and the antenna is placed at the center of the spherical radome, the symmetric shape of the radome cancels out axial ratio degradation from the oblique incidence angles seen by the antenna.

Radome Performance Variables

A well-designed radome provides environmental protection with minimal effect on the RF performance of the antenna and system. Electrically, the main concern for the radome is insertion loss — which reduces the available signal and decreases effective radiated power and G/T (the ability of the antenna to receive a weak signal). Radomes can also increase antenna sidelobes, resulting in interference with other communication systems, and increasing the likelihood of signal detection/interception from unintended observers. Radomes can also impact antenna polarization schemes, depolarizing circularly polarized antennas, for example.

Depolarization is generally very small for spherical radomes, but can be severe for radomes with large incident angles (missiles and aircraft). Other electrical effects include change in antenna beam width and shifting of the antenna boresight.

In addition to the effects of the material, nothing degrades radome performance more than a thin sheet of water, which has a very high dielectric constant and loss tangent at microwave frequencies. Non-hydrophobic surfaces cause water to stick to the radome creating a thin film, which serves as a shield to RF transmission and results in significant signal attenuation. Well-designed radomes feature a hydrophobic surface that causes water to bead up and run off. Even in high rain conditions, radomes with hydrophobic surface have little additional attenuation.

Although the radome is often an "afterthought" to an RF/microwave system, it is essential to overall system performance and lifetime cost. A well-designed radome not only provides environmental protection that ex tends the operating lifetime of the system, it also contributes to stable electrical performance and reduced maintenance efforts and downtime.

About MFG Galileo Composites

MFG Galileo Composites is a specialized radome engineering and manufacturing company with an unmatched composites engineering capability. As the only specialist in the design and manufacturing of composite radomes that is supported by a dedicated materials R&D lab, and part of a larger corporation dedicated to composites manufacturing, MFG Galileo provides the most highly researched, engineered and tested products on the market today. MFG Galileo Composites has produced more than 500 radomes for mission critical sites for military, space and scientific programs in 23 countries around the globe. The company's radome design and manufacturing techniques have been proven in the harshest environments on the planet including the Artic, Antarctica, desert climates, tropical climates, coastal climates and high elevation climates for surveillance, air traffic control, weather radar, SATCOM, earth observation, telemetry applications.

R I A T W

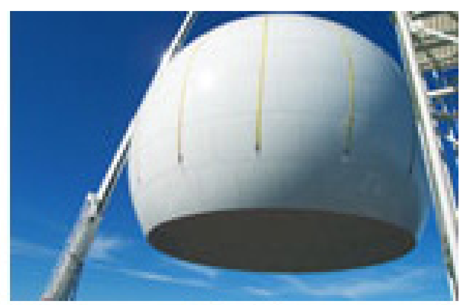
Barrow, Alaska

Guam

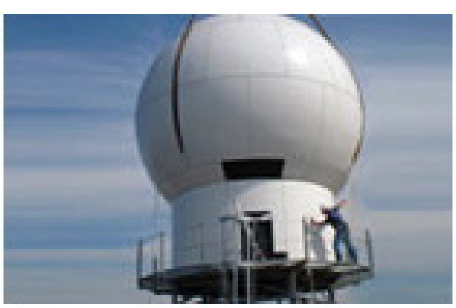
Guam

Chile

Chile

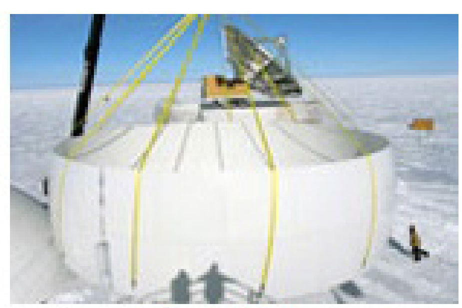


Hawaii



Greece

Salt Lake, Utah



South Pole

by Heather Eagle, Marketing Manager, SkyTerra

T*he situation* — there are many lines of work that are considered dangerous or at the very least risky to some extent... police, firemen, miners, oil riggers and 'crabbers' to name but a few. However, according to the Discovery Channel's sources, Alaskan 'crabbers' are top of the list in the business of... risky business.

"***Crabber***" is the name applied to those who challenge the high seas north of 60°, risking their lives for a two-to-five week period once a year in pursuit of the Alaskan king crab. Alaskan crab fishing is considered to be one of the most dangerous jobs in North America.

Every year, hundreds of seemingly fearless crabbers endure 20+ hour shifts for days at a time, in extreme weather conditions: 40-foot waves, 80-mph winds and sub- zero temperatures, all with the hope of netting their share of one of the most desirable seafood delicacies in the world – the Alaskan king crab. Approximately 10 to 15 million pounds of crab are estimated to be caught every year by the crab fishing fleet of just over 300 boats.

The challenge is to obtain a reliable satellite communications system for operation north of 60° that operates successfully in extreme environments.

The Solution

For a week prior to the start of the fishing season, crabbers flock to the small town of *Dutch Harbor*, Alaska on the island of Unalaska. There, the crabbers they retrieve their pots, food supplies, fuel, and bait as they ready themselves for the upcoming, rigiorous weeks at sea. There are a number of satellite carriers offering service north of 60°; however, **SkyTerra**'s

Crabbers endure 20+ hour shifts for days at a time, in extreme weather conditions

dispatch radio is the service of choice for the Pacific fishing community.

Using dispatch radio service for its flat rated, one-to-one, and one-to-many, service allows for an easy to use, push-to-talk, voice service in the most remote corners of North America. In fact, the ship captains refer to the SkyTerra dispatch radio phones as '***TAG***' phones – a label they use in reference to their talkgroups. A captain of one ship might say to another captain "I'll call you on TAG 1".

For the crabbers, this service is often the only means of communication. In these remote ocean regions, where being 'on the edge of the world' is truly a reality, the ability to simply push a button and hear a voice can often mean the difference between life and death. For most crabbers, this is a capability they simply cannot live without having available.

MSAT G2 Radio

The crabber *Time Bandit* heads into a wave. To get a perspective of size, figure the rail on the bow is likely 15 to 20 feet above the vessel's water line. Photo courtesy of Discovery Channel

With seasonal fishing quotas to fill on crab, cod, halibut, pollock, hake, and squid, the Pacific fishing fleet now numbers more than 1400 MSAT units. From the Pacific Mexican Coast to the far reaches of the Aleutian Islands, the MSAT 'TAG' phones have become as popular as the common cell phone.

Whether using dispatch radio, circuit switched data to download maps and weather reports, catching up on emails, or simply making a voice call to a loved one back home, the ***SkyTerra Network*** has become part of doing business for those who dare to challenge the seas of the northern Pacific Ocean.

About the author

Heather Eagle holds an English/Psychology degree from York University and Magazine Journalism from Ryerson University. Heather joined SkyTerra in October 2004 with a solid background in marketing communications and has served as Editor of several corporate magazines and newsletters. She also teaches Communication Dynamics in the School of Part-time Studies at Algonquin College.

Addressing Net Development and Maintenance Costs With ASR

by Mark Pitts, V.P., Business Development
Vados Solutions

Improvements in network technology are causing capital expenditure to decrease as a proportion of total cost of ownership (TCO). According to a recent report from Gartner, the capital cost of a network now only accounts for some 10-20 percent of the TCO. This means that to improve efficiency and reduce costs network managers have to simplify their network operations rather than focus on the feature set itself.

Those organizations that use VSAT or hybrid network application scenarios need to examine the total management offering from their suppliers, rather than a focus on capital expenditure items alone. Operational expenditure is often hidden and not taken into account when looking for new products and solutions.

Reducing Network Operational Costs

High operational costs are being incurred by many Service Providers, Network/Satellite Operators and end users when developing new or maintaining existing, multifaceted network architectures. Addressing these costs is vital in ensuring a reduced TCO.

This ***Auto Sky Roaming*** (**ASR**) article demonstrates an alternative approach to managing complex network and configuration schemes, by the implementation of an end-to-end network management and configuration solution that greatly simplifies and blends Inmarsat, VSAT, Coastal Wireless and other network topologies into one service offering.

ASR is a comprehensive, end-to-end VSAT/IP/Legacy communication management solution that provides blended mobility, roaming management, auto-configuration and quick system installation and provisioning, able to operate in any hybrid network environment (VSAT, Inmarsat, IP, PSTN, Lease Line & Wireless).

ASR simplifies the role of network planning and configuration teams. Combined with Vados Systems single platform network solution, it significantly improves network utilisation, helping to reduce costs and improve efficiency.

Business Drivers

This article demonstrates an alternative approach to managing complex network and configuration schemes, through the implementation of an end-to-end network management and configuration solution that simplifies the role of network planning and configuration teams and seeks to reduce network operating costs. Together with Vados Systems single platform network solution, network use and efficiency is significantly improved.

Overcoming Challenges Vs. Reducing Operational Expenditure

Whether you are a satellite operator managing a VSAT network; deploying *Communications On The Move* (**COTM**); managing hybrid networks; managing roaming wireless networks; ship owner, or operating in the maritime sector, the challenges remain the same — how to simplify the operating cost model, introduce, integrate and blend new service deployments quickly and reliably, whilst maintaining control of operational costs.

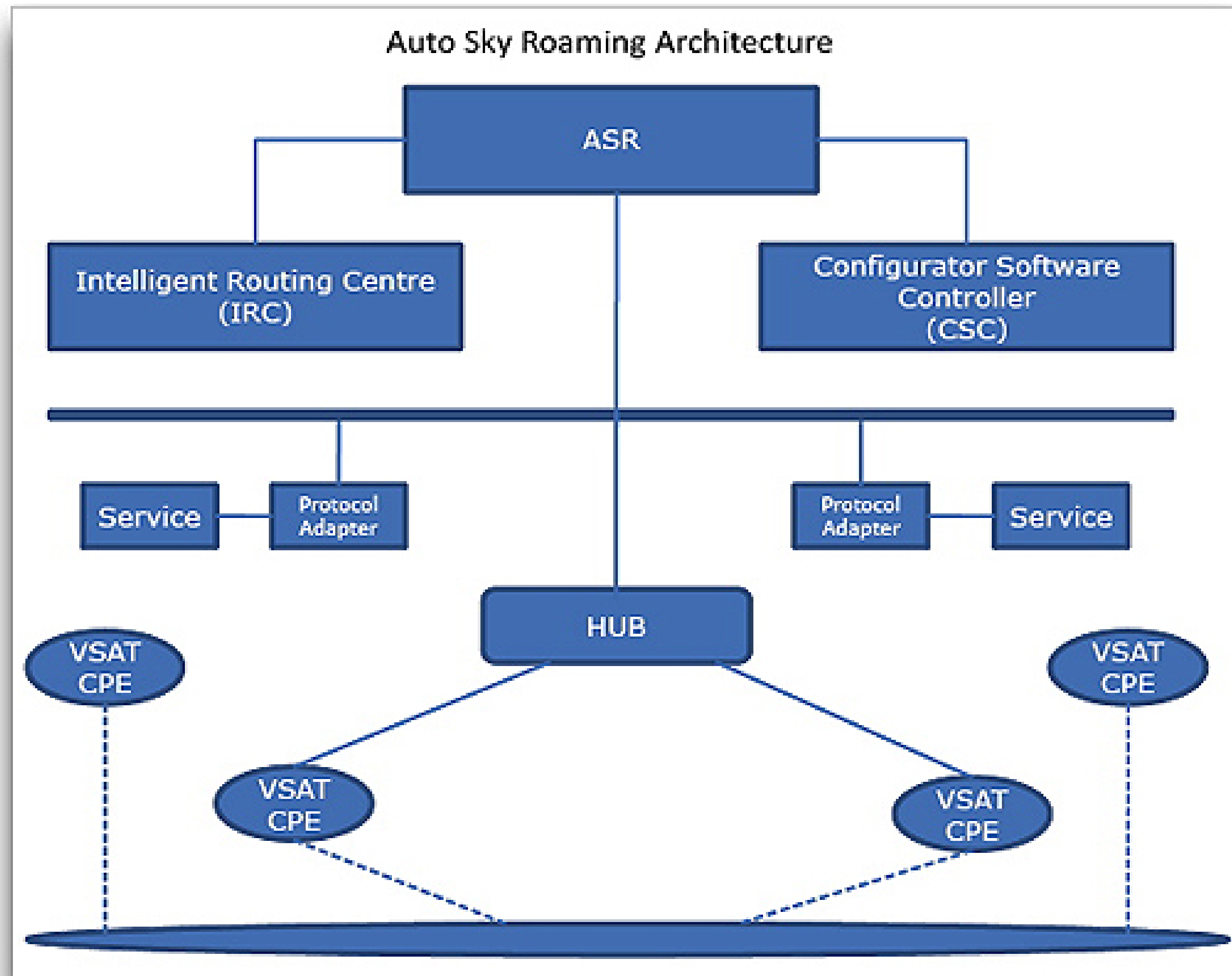


Figure 1 — ASR Architecture

Vados Systems has developed an innovative management solution called ***Auto Sky Roaming*** (**ASR**) that addresses three key communication network needs:

- Automatic software and configuration downloads — recognition, synchronisation and configuration across all satellite and terrestrial network nodes.
- Automatic traffic re-routing for satellite and/or terrestrial networks
- Uninterrupted service — maintaining original IP address and contact numbers during satellite and/or terrestrial network switch over.

ASR is a comprehensive end-to-end VSAT/IP/Legacy communication management solution that provides blended mobility, roaming management, auto-configuration and quick system installation and provisioning, able to operate in any hybrid network environment (VSAT, Inmarsat, IP, PSTN, Lease Line & Wireless).

The solution is transportable, scalable, and suitable for any organisation that has direct or third party control of their central site infrastructure and has a requirement for fixed or Communications On The Move (COTM) deployable communication solutions.

ASR Key Elements

- Zero Touch Configuration
- Seamless Network Routing

Zero Touch Configuration

Developed to simplify customer management with "Zero Touch" configuration functionality, ASR dynamically builds the configuration file and makes it available to the managed network. Thereby ASR ensures that all network nodes are kept at the latest configuration standard at all times, simplifying the management of the network infrastructure and eliminating the need to reconfigure essential services.

The solution greatly reduces the costs associated with transporting expensive engineering resources to repair, install and configure replacement equipment in failure and replacement circumstances. In many cases, existing remote-site personnel are able to activate the network

component with a quick and simple phone call, advising the service centre of the component identification number, located on the casing. Once connected onto the network, ASR does the rest, auto-detecting the new network component and automatically downloading the necessary configuration files and operating system software and activating the module.

The solution enables the centralized control and commissioning of any nodes across any network infrastructure. All nodes in the network are kept in synchronisation with the most up-to-date configuration files, reducing downtime due to configuration mismatch and incompatibility errors. Systems that have configuration problems can be controlled centrally with configuration tables managed from HQ or central hub locations.

Seamless Network Routing

ASR provides seamless routing between different satellites/network connections, with little or no operator intervention. In operation, the solution continuously monitors traffic and transparently changes the routing to match the current connectivity (*e.g.,* Satellite, ISDN, PSTN, Wireless, Lease Lines). The cut-over requires no routing protocol updates, and is initiated on the arrival of the first packet.

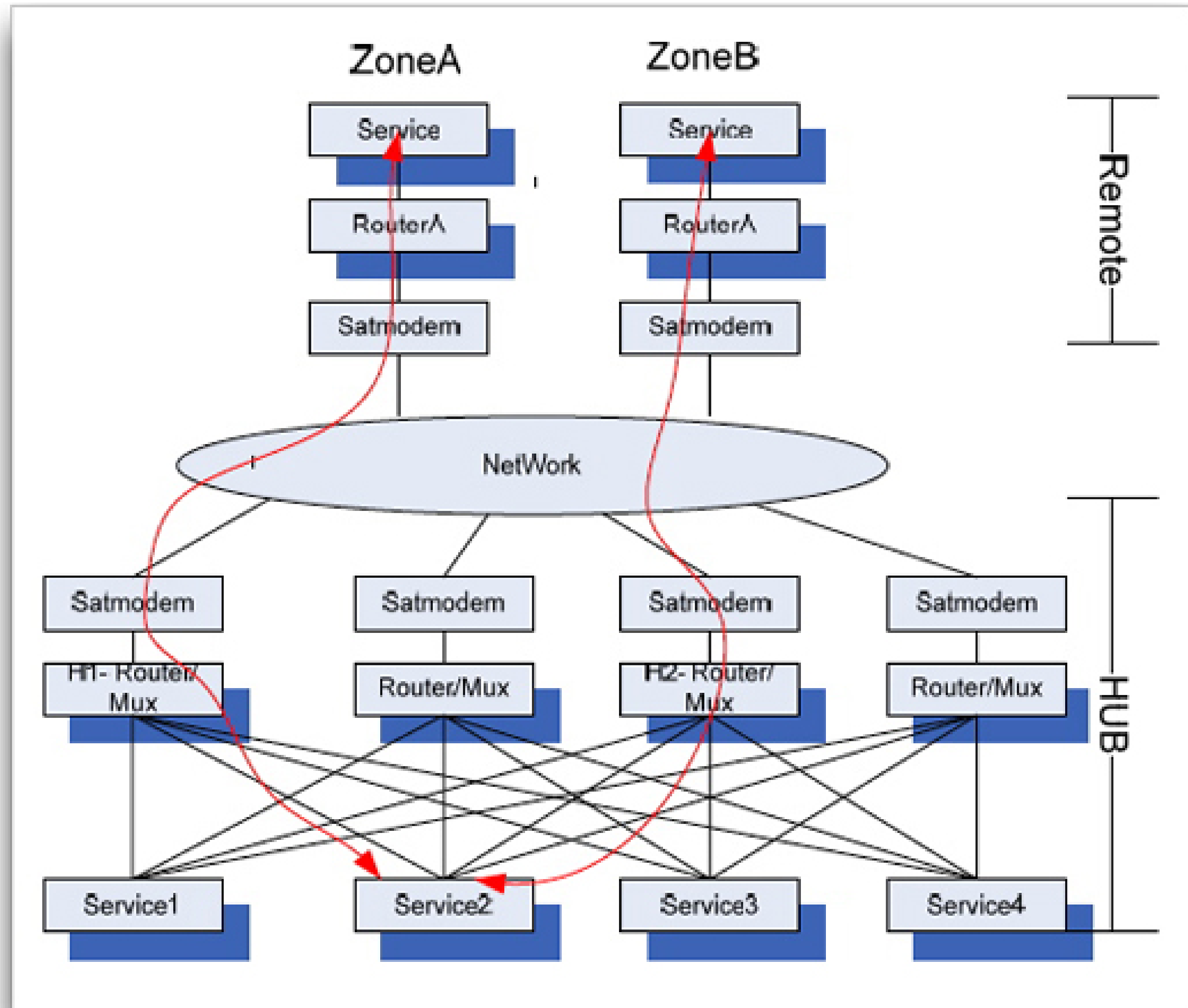


Figure 2 — Traditional network architecture

The solution can provide an automated satellite roaming capability, dramatically increasing the operational functionality of overlapping VSAT footprints. For example in the Maritime sector, the seamless blending between FleetBroadband and VSAT: ASR auto-detects the shift to the new satellite and initiates the voice and data traffic re-routing within the central site hub (Earth station). ASR initiates the change on the arrival of the first packet from the new location and operates completely automatically without the need for operator intervention. In operation, the vessel maintains their original telephone number, and any phone conversations that are taking place during the shift are maintained without the need for re-dial. The Vessel also maintains their same IP address irrespective of ground station location, negating the need to reboot onboard systems.

The major advantage of the solution is the support staff required to complete the migration will only need RF skills, with ASR dynamically managing the migration of the service onto the new satellite, allowing them to focus less on the day-to-day configuration and traffic routing, and more on customer services and new service creation.

The solution features built-in rules and thresholds as well as automatic device identification and data collection to help enable easy setup and immediate monitoring of the managed network. It is extremely flexible and can monitor any third-party VSAT devices that may exist in the network such as router and satellite modems.

Configurator Software Controller (CSC)

- Builds and stores the configuration file for the remote site CPE
- Provisions the Service across the network
- Intelligent Routing Centre (IRC)
- Central control software

- Manages the roaming and controls CSC
- Protocol adapter
- Hides the any-to-any infrastructure differences i.e. seamless to the user
- Converts all the service to LAN based

Figure 2 on the ***Page 48*** shows a traditional network architecture, the Router/Mux in the HUB needs to have a meshed connection to all the different services.

All traffic to ZoneA is routed to H1-Router. All traffic to ZoneB is routed via H2-Router.

Roaming RouterA works in ZoneA via H1-Router, when it roams to ZoneB, its traffic will be processed by H2-Router.

When RouterA moves to ZoneB (it moves to different geographical region or teleport coverage), the network management system needs to re-engineer the traffic to RouterA from H1-Router to H2-Router.

The remote router has to register the information with the corresponding HUB equipment.

When the remote CPE changes the satellite zone or in the event of a failure in the HUB (a satellite modem or router failure at HUB), the Router and the service system at the HUB needs to change the configuration correspondingly.

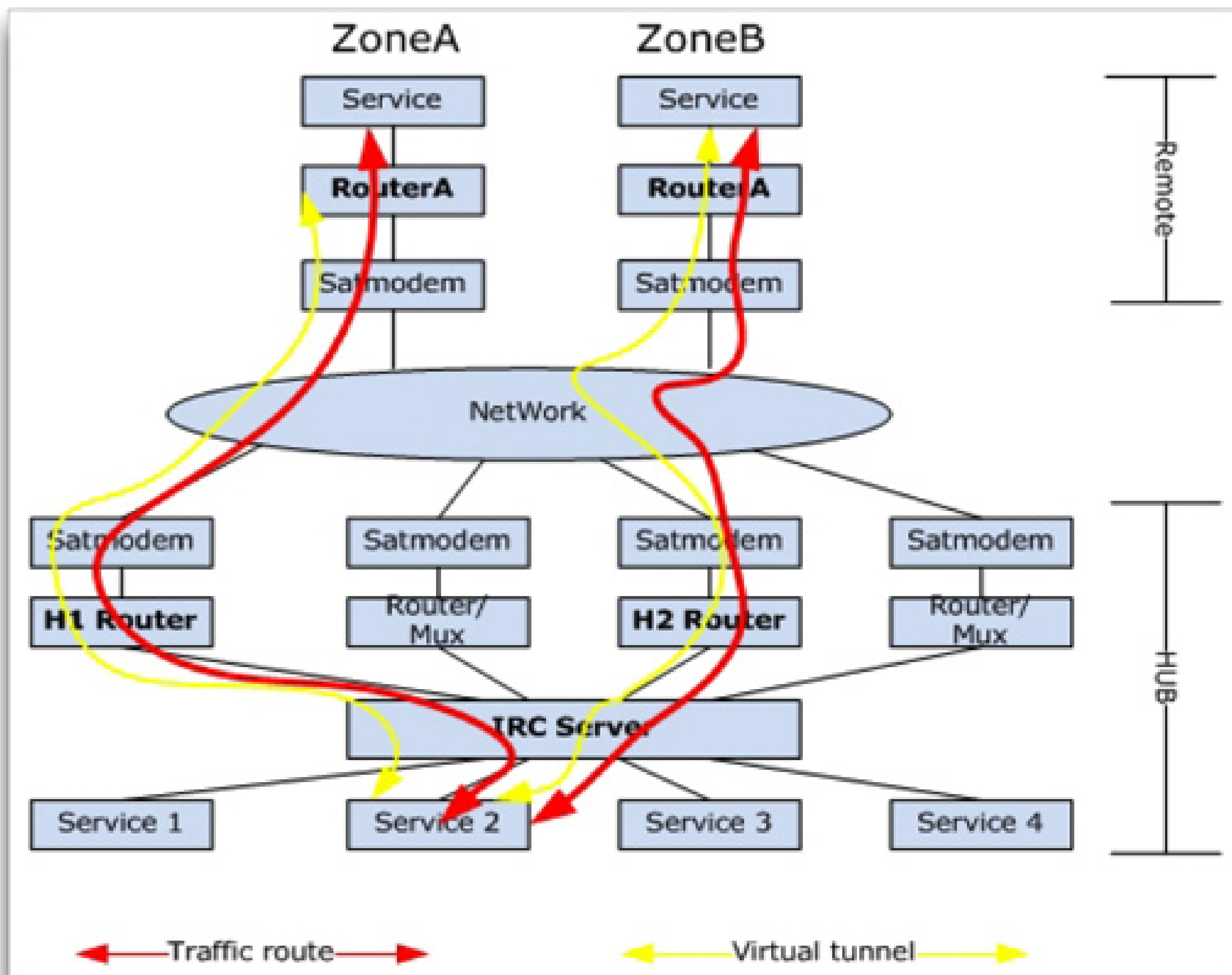


Figure 3 — typical ASR network architecture

When RouterA roams to ZoneB, RouterA needs to re-register at H2-Router. The traffic destined for RouterA needs to be reconfigured and re-engineered to H2-Router. The original service registered on H1-Router also needs to be cancelled. The system then notifies the changes and adjusts to it, resulting in a new network level configuration change.

Managing the traditional network architecture is exceptionally labour intensive and requires wide-ranging configuration and monitoring activities in order to maintain the user's service levels. In addition operational staff are required to maintain an accurate record of all the changes to the management system to ensure the service continues to work effectively after the change, often necessitating further testing and confirmation checks, adding to the resource overheads.

Figure 3 on the ***Page 50*** shows a typical ASR network architecture. The meshed network has been replaced with the Intelligent Routing Centre (IRC) with much reduced and simpler network connectivity.

ASR Key Features

- Auto-service switchover
- Automatic and accurate configuration generation and download
- Efficient network operation
- Reliability
- Scalability
- Service infrastructure independent

In the ASR solution a virtual tunnel is established between the IRC server and remote RouterA (Yellow line), all the service traffic is carried over the tunnel.

When RouterA was on its home satellite ZoneA, the traffic was exchanged between H1-router and RouterA (shown by the red traffic line).

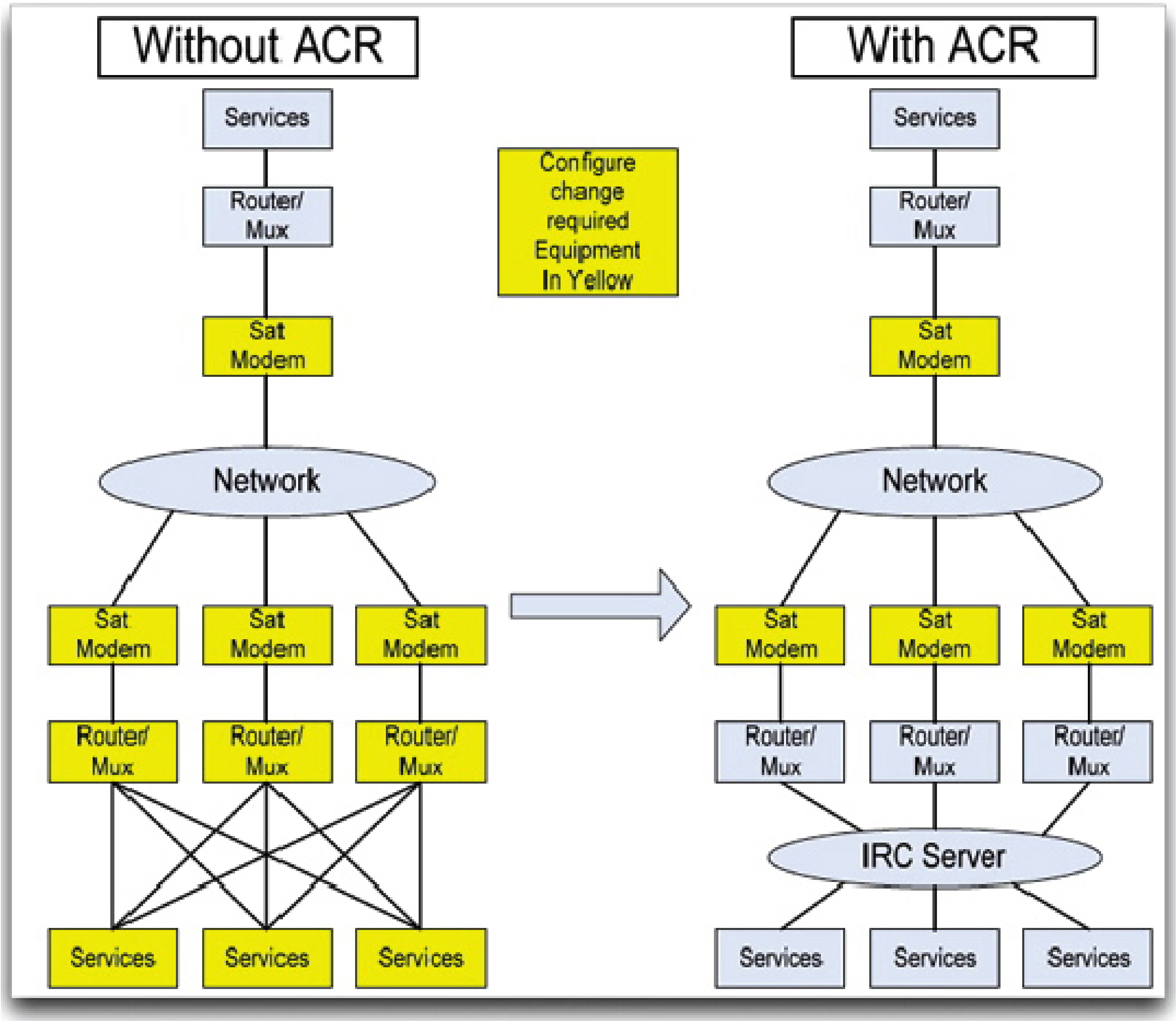


Figure 4 - a typical network without ASR and with ASR

When the user moves to ZoneB, the virtual tunnel still exists between the IRC server and RouterA, but the traffic is routed via H2-router.

The IRC server recognises the change and keeps a record of the remote router location, and routes the service traffic to the corresponding H1 or H2 equipment.

As the Tunnel is kept alive between the IRC server and RouterA, the service system does not notice any system or physical change.

The mechanism works the same in the event of a satellite modem failure at the HUB site, the traffic is re-engineered to another modem and the virtual tunnel is kept alive but by a different central router.

The network protocol adapter is used to convert the serial traffic to a LAN protocol and hides the network topology and the service differences. The service will not perceive any network level change (hardware and software level), and is completely infrastructure independent.

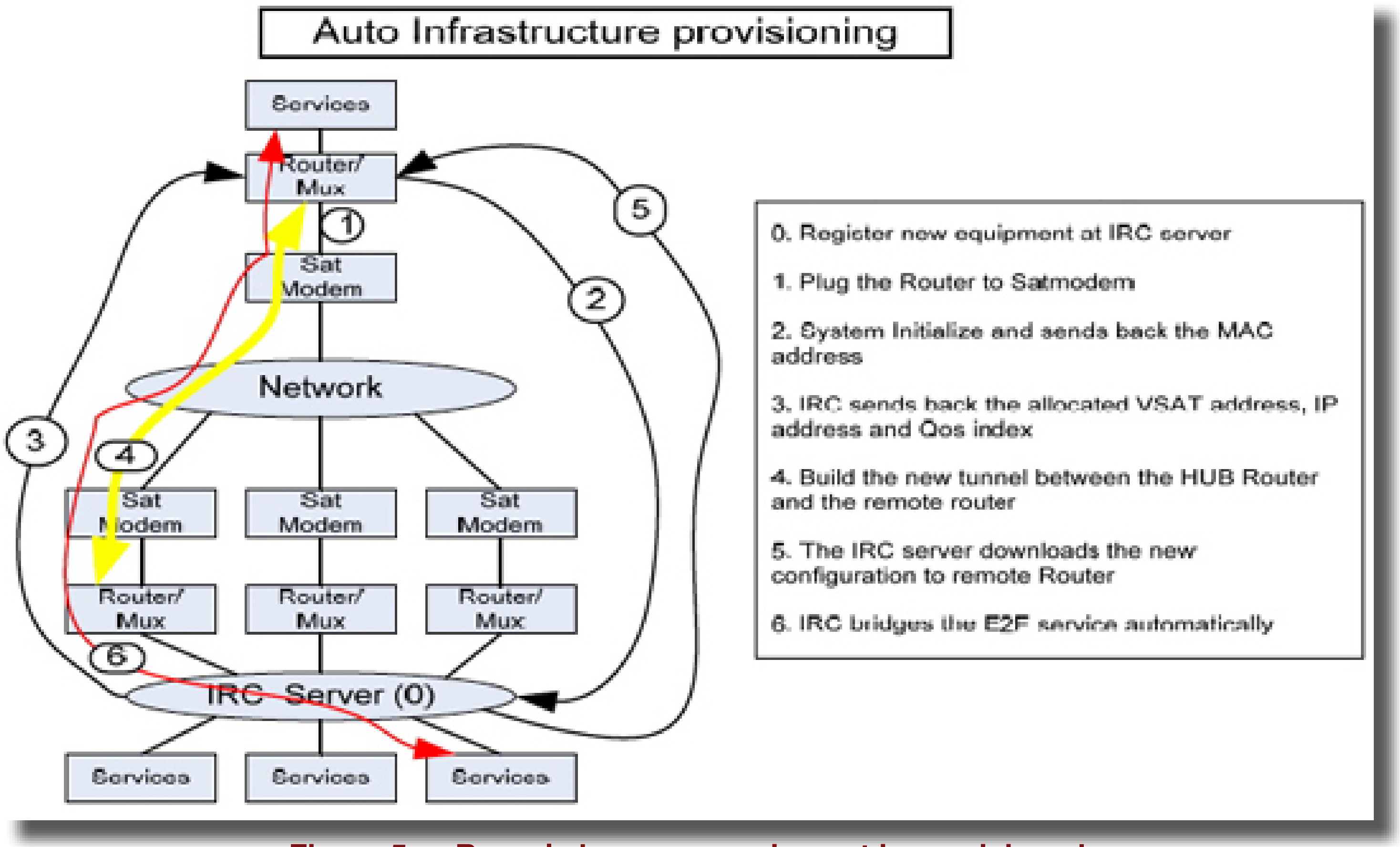


Figure 5 — Reveals how new equipment is provisioned

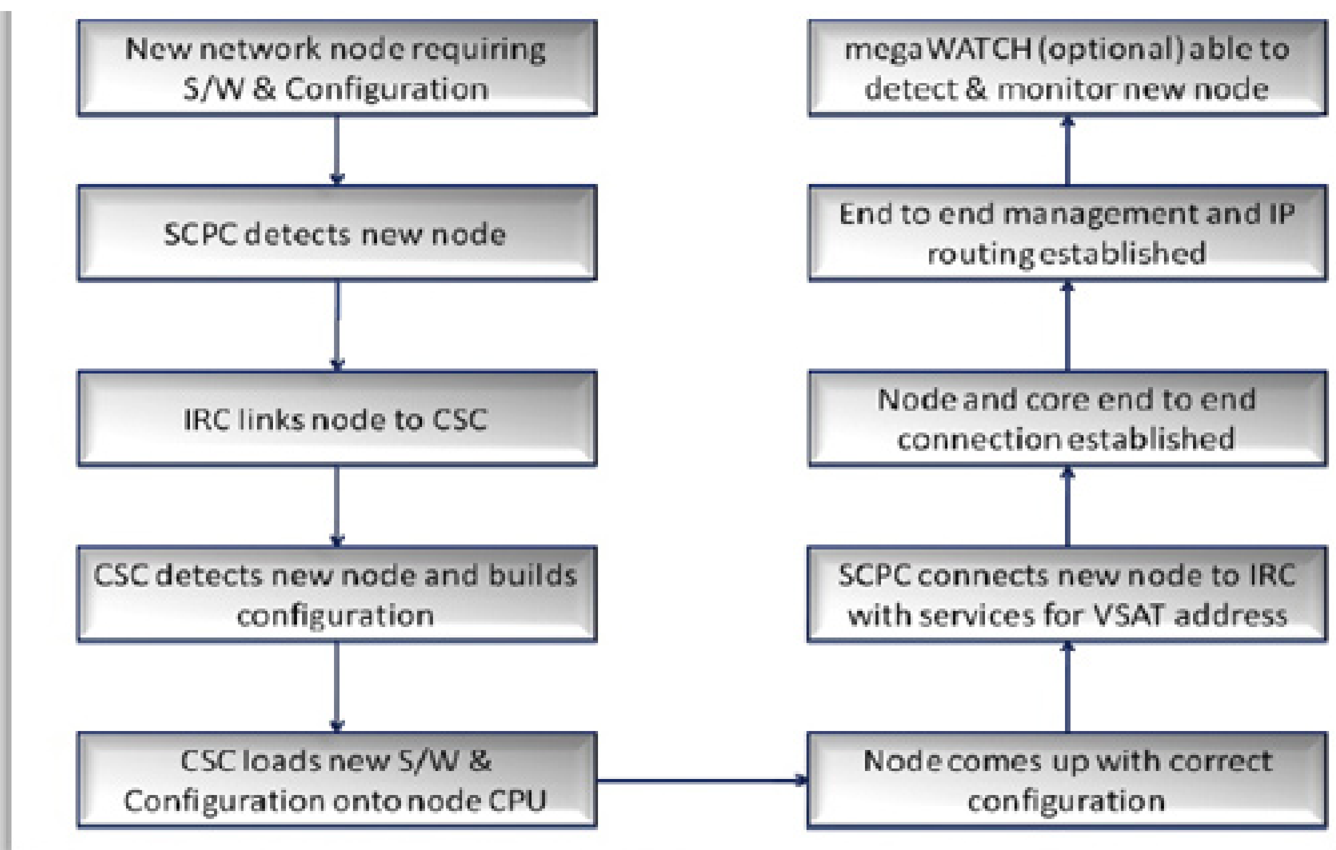


Figure 6 - schematic view of how equipment is commissioned

The IRC server coordinates the activities between the remote terminal and the service.
When RouterA moves to ZoneB, the IRC server identifies the Zone change and changes the configuration of the router at H2, ensuring H2 router is linked with RouterA.

As the service was hidden behind the IRC server, the IRC server will identify the change. The VSAT address and the IP address of the remote router remains the same. The IRC server stores all the configuration files and software images for all network equipment, and downloads the configuration files or alternative software to corresponding equipment as required. As the IRC architecture is totally independent of the infrastructure, it works with any satellite technology, *e.g.,* SCPC, TDM/SCPC, and IP.

Prerequisites of ASR solution

- Two links (out/in) required for each VSAT CPE terminal
- Unique MAC address across the network
- Unique V-TES address across the network

Figure 4 on ***Page 52*** shows a typical network without ASR and with ASR, support staff need only focus on the reliability of the equipment and network architecture. The routine equipment configuration and network tracking can be left to the ASR solution.

Plug and Play

ASR builds and stores the network configuration software and inventory information of the complete network infrastructure and so new service commissioning is achievable in very short timescales.

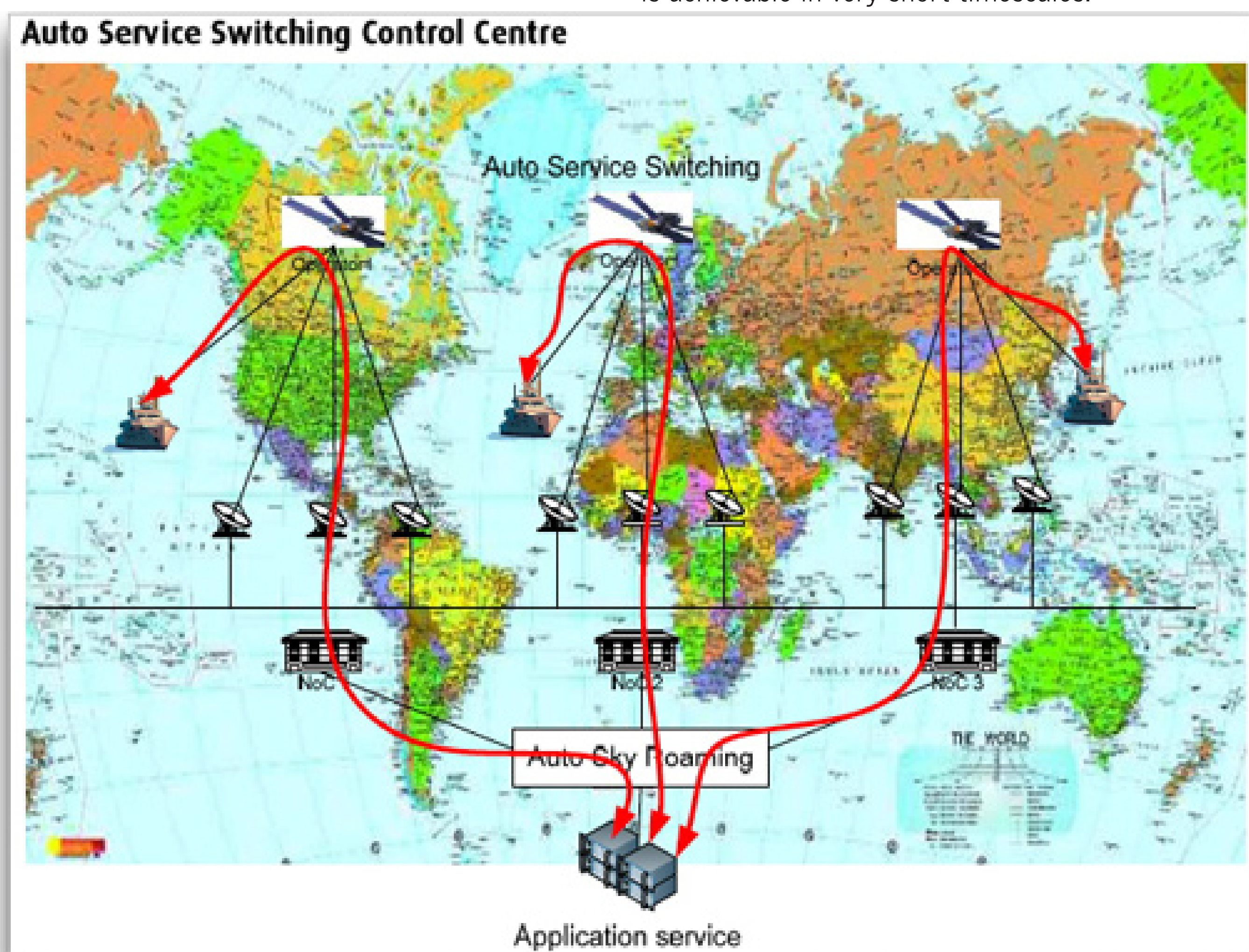


Figure 7 — shows how services can be switched between different satellite operators

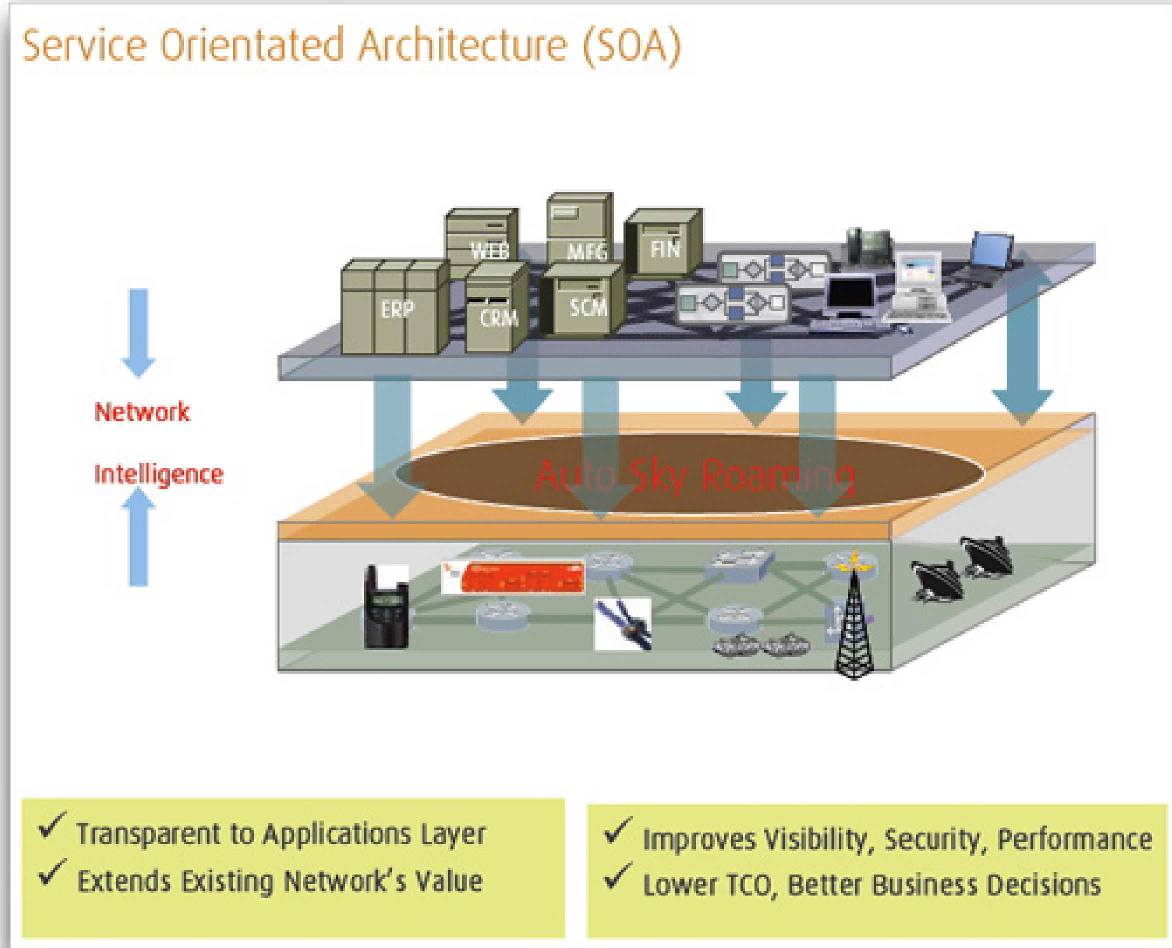


Figure 8 — a hybrid network solution

Once the new equipment is registered into the CSC server, it can be shipped to the site and connected into the network. When the equipment is powered up, it will find its way back to the HUB, no matter where it is located. The CSC server will then download the configuration and operating system software to the remote router.

Zero Configuration

The IRC server performs all the configuration and service provision. The remote routers are instantly activated when connected to the network.

System Security

The IRC server takes control of any system change configuration. An alert mail will be triggered when there are local configuration changes — this happens, for example, when an onsite engineer makes a change to the configuration. ASR provides customers with a reliable capability for time-critical system installation or system maintenance services:

- Quick service to market
- Minimum downtime
- Lower skill-set requirement
- Centralized technical skill sharing
- Hybrid network infrastructure support
- Global availability (only limited by satellite/network infrastructure)

ASR allows Service Providers to choose the most cost-effective airtime tariffs, from the available satellite operators, across any operating geography e.g. hybrid VSAT or INMARSAT services. Thereby increasing price flexibility and maximising operational return on investments.

ASR can be deployed as the central service control system providing end-to-end network monitoring and auto-service switching, with minimal or no operator intervention. Users can switch the service between different satellite operators to achieve the best tariffs, and can operate in wired or wireless infrastructures.

Unified Hybrid Network Management Solution

ASR is not dependent upon the VSAT or Inmarsat satellite network infrastructures, making it a perfect fit for hybrid network management and system provisioning. The systems *Intelligent Routing Centre* (**IRC**) server also acts as the service control centre and can interconnect into any service scenario.

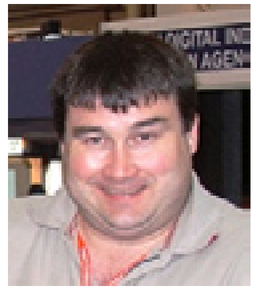
Summary

ASR provides an any-to-any hybrid network management solution, the customer does not need to be concerned about the network layer infrastructure differences, as the solution virtualises the network layer, and the services running above never identifies any infrastructure change. The end user is finally released from the day-to-day activities around routing and network management and is, instead, able to focus on the network architecture and new service creation.

Network managers need to simplify their network operations and improve network and operating efficiency rather than focus on the feature set itself. Capital expenditure is reducing when compared to the *Total Cost of Ownership* (**TCO**) and tends to be approximately 10 to 20 percent of the TCO, while the operational expenditure is increasing (*Gartner 2006*, ***Dataquest Research Catalogue: Carrier Operations and Strategies Worldwide***).

Customers in the VSAT or hybrid network application scenarios need to think about the total management offering from suppliers, rather than a focus on capital expenditure items alone. Operational expenditure is often hidden and not taken into account when customers are looking for new products and solutions.

About the author



Mark Pitts is responsible for overseeing the company's core Solutions Development and delivery of a broad portfolio of voice and data communications solutions to the government, maritime, aeronautical and enterprise markets. Mark manages business development, directing the company's next generation technology platforms. He is also responsible for building technical and engineering relationship with key users of Vados Services in the military and civil government, and commercial enterprise sectors.

Mark served in a Business/Solutions Development role of Satelcom Ltd from 1994 (becoming Solutions Director in May 1999), and was appointed to the Board in December 2003. Prior to joining Vados Systems he was the Network Solutions Architect for public sector solutions such as Fire & Rescue to Child- at-Risk register solutions. Prior to this, between 1984 and 198, he held a number of business development and technical positions within the network industry.

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